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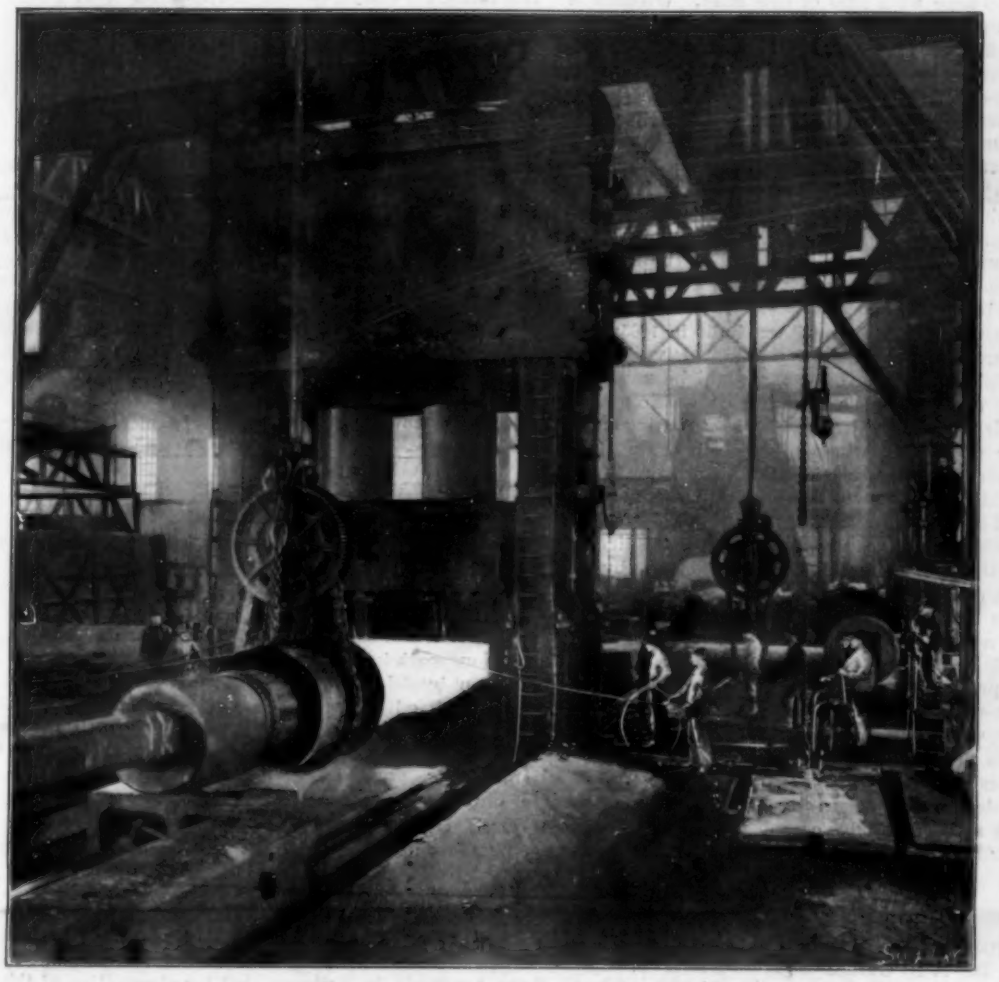
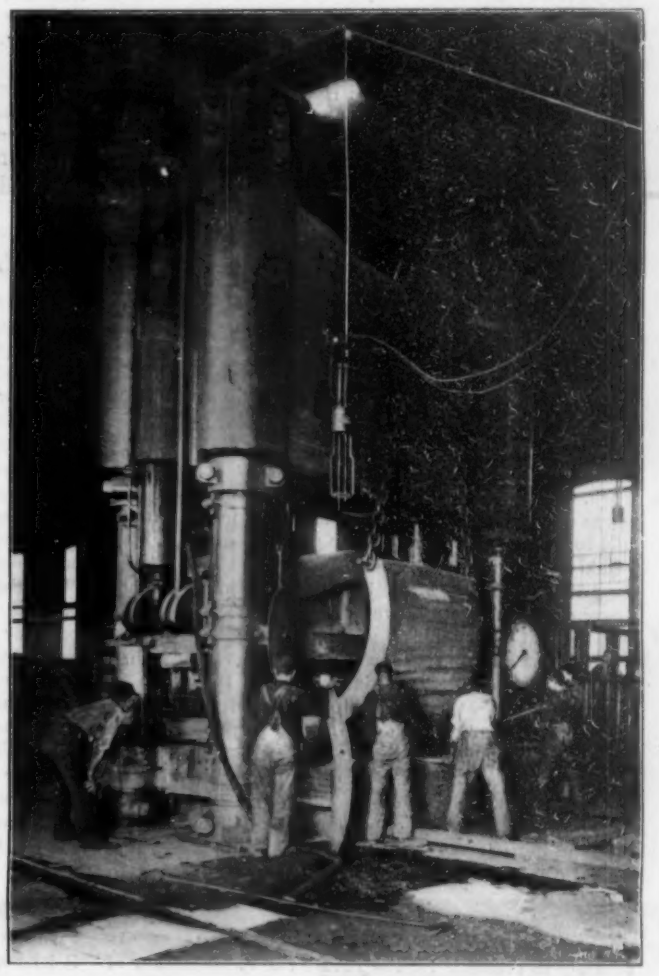
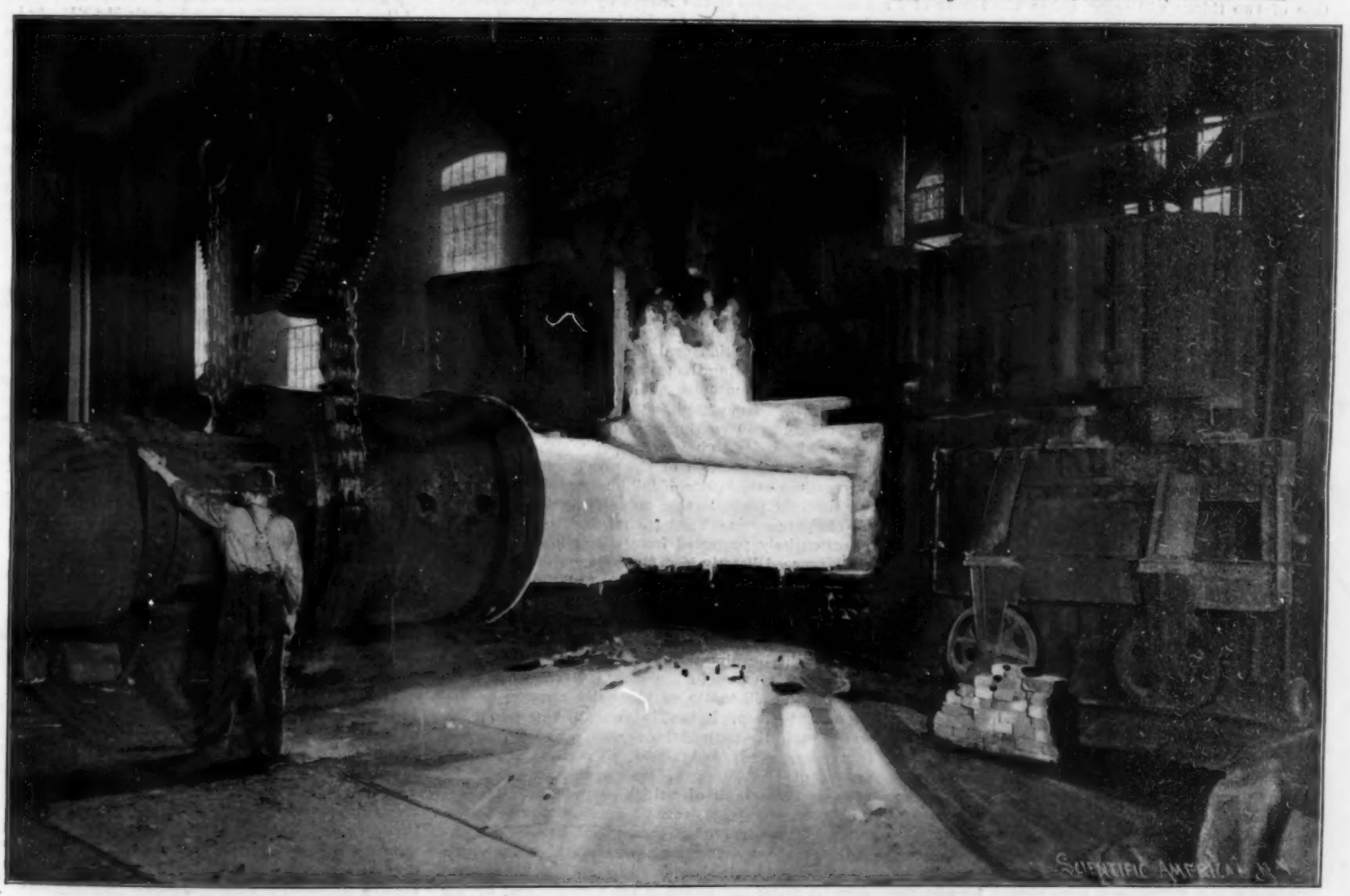


Forging a Port Plate of the "Alabama" Under the 14,000-Ton Press.



Bending Armor Plate Under the 7,000-Ton Press.



Transferring the 125-Ton Forging for a Port Plate of the "Alabama" from the Furnace to the 14,000-Ton Press.

MANUFACTURE OF GUNS AND ARMOR AT THE BETHLEHEM STEEL WORKS—III. HARVEYIZED ARMOR.—[See page 24.]

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NEW YORK, SATURDAY, JULY 14, 1900.

FIRE-PROOF DOCKS—THE MORAL OF A GREAT CALAMITY.

The tragedy of June 30 has taught us that we may no longer associate ideas of absolute security with the wharves and piers at which shipping loads and unloads in the interim between its various deep sea voyages Three costly steamers, four large piers, and a pitiful death roll of over three hundred souls sent to swift destruction, is a record that may well shake our confidence in the safety of the system of dock construction now in vogue in the port of New York. It would be the blindest folly, and would betoken a criminal indifference to the value of human life, to ignore the obvious lesson of this disaster, which teaches us that wooden docks and pier sheds of the kind that were consumed like tinder around the imprisoned unfortunates have no lawful place among the buildings of a great metropolitan city.

There is a certain sense in which it is fortunate that the disaster was as great as it was. Had it been less, we might have settled down into the old methods of construction, and continued to build piers and sheds that are a positive disgrace to the capital city of the New World. As it is, the devouring fire did its work so completely and with such portentous suggestion of what might have happened, had the calamity taken place an hour or two earlier, when one of the trans-Atlantic ships was just setting out on her voyage, to the usual accompaniment of crowded docks and crowded decks—that only one result seems possible, and this is, that steps will forthwith be taken absolutely to prohibit for the future the construction of wooden piers and pier sheds.

One of two things will occur, either the horror of that Saturday afternoon will pass only too swiftly out of the public mind and our wharves will continue to invite another holocaust whenever a steamer loads and unloads at this port, or we shall accept and put at once into practice the imperative lesson that has been taught us.

To be sure, it is out of the question to advocate the wholesale pulling down of the existing docks and their rebuilding with concrete or masonry. On the other hand, laws should certainly be passed regulating the construction of all future docks, and specifying that they shall be as secure as the latest methods of fireproofing can make them. At present there are scores of wharves and sheds that are eminently qualified, not to retard, but to assist the spread of fire. Standing upon piles which allow a free draught of air to pass beneath and up through a burning structure—constructed with wooden floors, wooden posts and framing, and wooden roof-trusses—with dust lying thick in every corner and on every beam and rafter—with floors that are frequently oil-soaked and strewn with combustible fragments worn off from the floors themselves, and torn from the goods in transit—these huge tunnel-like piers and sheds, reaching, as they do, anywhere from 600 to 800 feet into the river, without a single partition to stay the sweep of the hot gases and flying débris of a fire, seem to possess every element that could conduce to just such a prairie-like rush of fire as occurred in the recent disaster.

Of course, the piers are not all equally perilous, the new docks occupied by the White Star and Cunard Lines on the New York side, and one, at least, of the destroyed docks of the North German Lloyd Company, were of greatly superior construction to the many fire-traps along the water front which only await an opportunity to repeat the Hoboken disaster. Nevertheless, it is a fact that with the exception of the two masonry docks at the Battery, there is not a pier in the harbor that can be called strictly fireproof.

Why is it, we ask, that with all the care and expense which have been lavished in producing fireproof buildings on shore, we have practically made no effort to apply fireproofing to our docks? The North German Lloyd calamity has proved, surely, that the call for fireproofing is as urgent, nay, more urgent, for wharves and piers, crowded as they are at steamer sailings, than it is in the less densely populated buildings on shore. If the cost of masonry construction is considered to be prohibitive, it is surely not too much to ask that all timber used shall be thoroughly fireproofed; and, indeed, in view of the comparatively small difference in cost between a timber and a steel pier-shed, it would be no great hardship to insist that all future sheds shall be steel-framed, and sheathed with corrugated iron.

Another important lesson of the fire is the necessity of organizing a separate river fire department, whose plant, organization and training shall be specially qualified to cope with fires of this kind. Without in any way detracting from the excellent work done by the fireboats and the various tugs on that fatal afternoon, it cannot be denied that a thoroughly organized floating fire department would have done more in the way of saving life and the salvage of ships than was accomplished by the well-meant but disorganized efforts of the river tugboats. A special department of this kind should have a half dozen fireboats for every one that the city now possesses.

A further lesson is suggested by the fate which overtook the unfortunates imprisoned within the steamer "Saale," whose lives might have been saved had the portholes been a few inches larger. It is true that the latest steamships (the "Saale" was built in 1886) have larger portholes than were found in this vessel, and only a slight increase in diameter would be necessary to allow egress from a burning or sinking ship. The modern steamship carries a towering mass of upper works, the whole of which, because of its open construction, is liable, if ignited in a strong breeze to be rapidly converted into a sea of fire—as actually happened in the case of the burned ships. With these upper works on fire, escape by hatchways and stairways is impossible, and the only means of exit is by the portholes, coal-ports and gangways.

We are aware that sudden disasters are liable to provoke a hasty condemnation of existing conditions and a demand for the most extreme and impossible preventive measures. If any of our readers are disposed to consider our suggestions as being of this class, we ask them calmly to consider what would have been the loss of life had the Hoboken fire started say five minutes before a departure of the "Kaiser Wilhelm der Grosse," when possibly from two to three thousand souls would be crowded on the ship, the gangways and the piers?

AN IMPROVEMENT IN RADIOGRAPHY.

In a paper lately presented to the Académie des Sciences, Dr. T. H. Guilloz describes a series of experiments which he has recently made which show the remarkable diffusion of the X-rays by the surrounding objects, and the importance of this action in radiographic work. It is, in fact, difficult to obtain a good radiograph of the thicker portions of the body which will have a good contrast, and the plates thus obtained generally show more or less fog in the development. This cannot be explained by a pure and simple absorption of the rays; it has been supposed by some that the action was due to the diffusion of the rays by the air, but this is, in fact, so small as to be entirely negligible in practical work, and could not produce the effect observed. After a number of experiments Dr. Guilloz seems to have established the fact that this action is due to the diffusion of the rays by the surrounding objects, such as the supports, containing apparatus, walls of the room and tissues of the subject, and in some cases by the body of the operator.

The following experiment shows how strongly worked is this secondary action or diffusion of the rays, The vacuum tube emitting the rays is placed above a large plate of lead about one meter square and two millimeters thick. The plate has a rectangular opening in the center, 4 by 10 centimeters, which allows the rays to pass. In order to have a region which is entirely shielded from the action of the rays passing through the opening, a steel plate, 15 millimeters thick, is placed over the lead plate, having one side in line with the side of the opening. The region below the steel plate is thus entirely protected from the action of the rays which proceed directly from the source, this being verified by using a fluorescent screen of platinocyanide of barium, and it was found that it was impossible to obtain a silhouette of the hand or other object when placed against it. If now an attendant covers with his hand the opening through which the rays pass, or if the hand is placed in the path of the rays near the opening, the silhouette of the hand appears on the fluorescent screen. In fact, it is only necessary to place an object in the path of the rays, at any point where it may be viewed from the screen, to cause an illumination of the latter. It seems, therefore, that in taking a radiograph of a thick part of the body, secondary or reflected rays are produced, not only at the surface of the body, but throughout its whole thickness, and the experimenter shows several radiographic plates which he has obtained by an exposure of two minutes under the action of the rays diffused by the body.

The negatives were obtained by placing a photographic plate in the position previously occupied by the fluorescent screen; the plate was wrapped with black paper, and one-half of it covered with tinfoil. An exposure of two minutes was made, placing before the uncovered half of the plate a pocketbook, the fingers, etc., this being done after all objects were carefully removed from the path of the rays. The tinfoil was then transferred to the other half of the plate and a second exposure made, while an attendant covered the opening with his hand. Upon development, the plate showed on the first half a scarcely perceptible image, this being, no doubt, due to a slight diffusion from surrounding objects; the other half, on the contrary, showed a vigorous impression, caused by the rays diffused from the hand. The experimenter lays stress on the fact that in taking a radiograph the operator should consider all the surrounding objects as capable of diffusing the rays, which strike the plate and produce a fog, especially with long exposure. In the case of those parts of the body which have but little thickness, this action may not be very perceptible, but for the trunk of the body, for instance, where a long exposure is necessary, these secondary rays play an important part, and the surrounding objects may give off rays which have the same order of intensity as those which have passed through the body. The best method of avoiding this action is probably to surround the subject by a lead plate which follows the contours of the part in question; a metal diaphragm may be used to advantage in front of the tube.

CURIOUS CHEMICAL COMPOUND.

M. Maurice François has succeeded in producing a compound which has been hitherto looked upon as somewhat hypothetical, namely, the iodide of dimercurammonium. He has recently undertaken a series of experiments in which he forms this body in the amorphous and also in the crystalline form. The only previous work in connection with this body is that carried on by Weyl, who claims to have obtained the anhydrous iodide by treating, under pressure, mercuric iodide by liquefied ammonia; he considered it a very unstable body, and, in fact, scarcely to be perceived in the reaction. This body has been considered as taking the hydrated form, and its formula has been given as Hg_2NI, H_2O, or else, by considering that the oxygen enters into its constitution, the formula is written:

$$\begin{matrix} H\,O\,Hg \\ Hg = N - I \\ H \end{matrix}$$

in which H O Hg is considered as a monatomic group. The experimenter states in a communication made to the Académie des Sciences, that his observation of the body leads him to conclude that it is always anhydrous and that it corresponds to the formula Hg_2NI. As he produces it, it appears to be a very stable body, taking the amorphous or the crystalline form, according to the process of preparation.

After some preliminary work, he finds that the amorphous form is best prepared by the following process: 30 grammes of mercuric iodide are carefully mixed in a glass mortar with 30 c. c. ammonia (D = 923), and the soft paste thus formed is transferred to a flask containing emery. It is left to stand for twenty-four hours, and at the end of that time the white mass is placed in a mortar and 90 c. c. of a soda solution of 25 per cent strength is added. It is well mixed and left under a bell-jar for five days, the mass being stirred from time to time. The clear liquid is then poured into a funnel whose neck is stopped with cotton, the remainder is added and the whole filtered. The matter is then mixed in the mortar with 90 c. c. soda solution, and left as before for five days, after which it is again filtered. It is treated a third time in the mortar by the same quantity of soda solution and then placed in a porcelain dish and heated for two hours in a water bath kept at the boiling point. It is then washed by decantation and dried at 50° C. One thus obtains 18 grammes of the iodide of dimercurammonium, which gives by analysis nearly the theoretical values corresponding to the formula Hg_2NI.

To produce the crystalline form of iodide, which the experimenter now obtains for the first time, its formation must be carried on very slowly, in which case the crystals are deposited. The experiment is carried out as follows: 10 grammes of mercuric iodide are mixed in a mortar with 50 c. c. of ammonia and left to stand for eight days, it being agitated once or twice a day. The liquid is filtered and is mixed in a dry flask with two volumes of ammonia. In this case there is produced, after 24 to 48 hours, a deposit of small crystals, which appear almost black. This deposit increases during ten days or more. The crystals are collected on a filter, and after drying in air they are washed with ether. The weight of crystals given with the above proportions is about 0·8 gramme. The iodide thus obtained in the crystalline form has a dark purple color when viewed in the mass; the crystals observed under the microscope are a dark reddish brown when seen by transmitted light. They are very well formed, with faces and angles of a remarkable clearness

TWENTIETH CENTURY ENERGY.

BY ALTON D. ADAMS.

Beyond doubt coal exerts the widest and most important influence on humanity. Coal constructs and drives the steamship, locomotive and electric car, lights the gas flame and the electric lamp, turns the wheels of industry, and makes habitable the factory, the office and the home. It brings to us a great store of energy from the sunshine of former ages. Unfortunately, our methods of using this product of Nature's laboratory are so wasteful that the greater part of the stored energy escapes without performing any useful work. The supply of coal is limited, how limited we do not know; but a just regard for people yet to be, bids us use with reasonable care this substance, for which science has thus far discovered no substitute.

The losses that occur in the application of the energy of coal to our purposes, result partly from a direct escape of heat during the process of combustion, but often to a greater degree when the heat is changed to motion, electricity, or light. In house stoves, furnaces, hot water and steam heaters it is variously estimated that from one-half to three-fourths of the energy of the coal burned escapes with the flue gases. The steam boilers of large power plants are more efficient than domestic heating devices; and the chimneys of such plants usually receive from one-fifth to one-third of the energy of the coal put into their furnaces. In the very general use of steam for the production of mechanical motion, much energy is lost. The steam contains from one-half to three-fourths of the heat developed by the combustion of the coal used; but the steam engine is able to deliver as mechanical power only from five to fifteen hundredths of the coal's energy. The generation of electricity on a commercial scale is at present entirely dependent on mechanical power, and the dynamo is a very efficient machine, delivering usually in the form of electric current as much as nine-tenths of the energy supplied to it. Unfortunately, however, the steam engine has been the only prime mover available for the general operation of dynamos, and the electricity delivered has been seldom more than one-tenth of the energy of the coal burned.

The production of gas from coal is a process of rather low efficiency. What is known as coal-gas contains about one-fourth of the heating power of the coal from which it is generated; but along with the gas, coke is produced to the amount of five or six-tenths of the coal's total heating capacity. Where the coke can be used or sold to advantage, therefore, the gas and coke together are a fairly efficient product. Nowadays water-gas is largely displacing coal-gas, because its production is cheaper. This water-gas has from five to six-tenths of the energy in the coal consumed for its output; but there is no coke remaining to raise the total efficiency. Coal-gas is suitable for either light, heat or power production, without additions of other substances, but water-gas is available for heat and power only when treated with heavy mineral oils.

The gas engine, whose development has now reached a stage that renders it of great importance as a prime mover, shows a marked improvement over the steam-engine in the matter of efficiency. For example, the best steam-engines deliver in mechanical work only about fourteen-hundredths of the heat energy in the steam entering them, while fair gas-engines convert into motion two-tenths of the heat energy of the gas they consume. This higher efficiency of the gas-engine is more than offset, for plants of fairly large size, not only by the difference in contained energy between coal and the coal gas or water gas it produces, but especially by the prices at which these gases are commonly sold. At one dollar per thousand feet, coal or water gas costs as much for power production as would coal at fourteen dollars per ton in a good steam plant. In small steam-power plants the consumption of coal is relatively very large, and this, together with the small amount of labor necessary for the care of a gas-engine, gives the latter a place where only a little power is wanted, in spite of the high price of fuel in the gaseous form.

For general heating purposes, coal and water gas make a poorer showing than coal. At one dollar per thousand feet, the cost for a given quantity of contained heat is about equal to that of good coal at forty dollars per ton. As more than one-half of the heat energy of coal usually escapes up the chimney, in house heating, and as there is a smaller loss of heat in this way when gas is the fuel, the probable cost of general gas heat is that of coal at from thirty to twenty dollars per ton, when gas costs one dollar per thousand feet. For many special purposes, where a small amount of heat is wanted during a short time, gas is, no doubt, the cheaper fuel, because it can maintain a very small fire, which can be started or extinguished immediately.

For a given illumination, the amounts of energy consumed at the lamp differ greatly between gas and electric service. The ordinary gas flame consumes about sixteen times as much energy to produce the same amount of light as does an incandescent electric lamp, and about sixty times as much as produces an equal illumination in the electric arc. In spite of the low efficiency of the gas-engine, when coupled to a dynamo, the gas used to drive it for the production of electricity yields three times as much light in incandescent lamps and about eleven times as much in arc lamps as would the same amount of gas give off if burned directly at gas jets. The electric heater is one of the very few devices for the transformation of energy that have a perfect efficiency, in that it sends out as heat the equivalent of all the electricity consumed by it. Notwithstanding this perfect efficiency, it can never play an important part in general heating, so long as the production of electricity depends upon heat-driven prime movers of low efficiency. But little more than one-tenth the energy of coal can be delivered to the electric heater, while coal-gas brings one-quarter and water-gas about one-half to the gas stove. While the gas-heater is not as efficient, considering the losses by imperfect combustion and escape of heat through the chimney, as the electric type, it still renders useful a much larger part of the heat-energy of coal. All of the conditions and operations that require heat, mechanical energy, electricity and light thus rest on coal for their production. Heat-energy from coal is more economically applied to power production, and in many cases to heating purposes, through the medium of gas, but coal and water gas contain so small a part of the energy in coal, and are sold at such prices that their advantages over steam at the engine, or over coal at the heater, are largely vitiated. Electricity shows great economy over gas for illumination; it is much cheaper for a given amount of light to use gas in the gas-engine to drive a dynamo and thus supply electric lamps.

A gas produced at a moderate cost, and charged with nearly all the heat-energy from its coal, would materially reduce the coal consumption and cost of heating, power production, and electric lighting. Investigations looking to the cheap production of such a gas have for some years been in progress, and at recent dates the desired results have been obtained in both Europe and America. This comparatively new product, known as "producer" or fuel-gas, contains fully eight-tenths of the heat energy of the coal from which it is made, and, moreover, this coal may be of the cheapest grade. This producer gas can be economically made in even small amounts, such as might be required for a private power or heating plant. It is also adapted for distribution on an extensive scale. The expense of the plant for the production of fuel-gas is moderate, being about the same for a small equipment as that of a first-class steam-boiler plant of equivalent power capacity. As the gas-producer shows an efficiency that is rarely reached in actual practice by the steam-boiler, and as the gas-engine requires only about two-thirds of the heat-energy in gas that the steam-engine does of steam for a given amount of mechanical work, a power plant or factory can save at least one-third of the coal necessary in a steam-plant by the use of a producer and gas-engine. Moreover, the gas-plant is at a decided advantage as to its ability to begin power production at the maximum rate or stop entirely, on a minute's notice, which cannot be done with the steam boiler and engine. In plants for the supply of electric energy to the public, for which the fuel consumed is a very important item, the properties of the gas producer and engine make them of especial value, and their use in electric stations should reduce the price for electric current. In large, private heating-plants, the gas-producer effects a saving over the ordinary steam or hot water equipment, though the gain is not so marked as where power is required. When used in a large plant for general heating, the producer-gas will be burned in a suitable steam or hot-water heater, and the saving will result largely from the cheap grade of coal used. The low heating power of coal and water gases, compared with the energy of their coals, the expensive plants necessary for the production of these gases, and their preparation for purposes of illumination, have all tended to make their general use for heating purposes impracticable. Producer or fuel gas, containing four-fifths of the energy from the cheapest grades of coal, instead of only one-quarter to one-half of the heating power from the more expensive grades, as do the illuminating gases, is available for the general supply of heat in towns and cities, at a rate comparing favorably with coal.

One ton of anthracite buckwheat coal in the gas producer yields on the average from 160,000 to 170,000 cubic feet of gas, which contains fully eight-tenths of the heating power of the coal. The total cost of manufacture for this gas on a large scale is certainly not more than three cents per thousand feet; doubling this amount to cover distribution, charges and profit would give the fuel-gas a selling price of six cents per thousand feet. Fuel-gas has about one-fifth of the heating energy per cubic foot that is contained by the coal and water gases, and at six cents per thousand cubic feet would be equivalant in cost of heating capacity to either of these gases at thirty cents per thousand feet or to coal at about twelve dollars per ton. Gas in house-heaters will give from two to three times as much of its contained heat-energy in useful effect as coal commonly gives and would really equal coal at from four to six dollars per ton at the rate mentioned. The great economy of fuel to be effected by the reduction of coal to gas before its general use for heat and power, and the substitution of glow lamps for the open flame, seem certain to make gas and electricity the forms of energy which will prevail in the twentieth century.

PARIS EXPOSITION NOTES.

Contracts for the dismantling and razing of the Paris Exposition buildings have been signed, and the job has been given to a Chicago firm which tore down the buildings after the Columbian Exposition, and also those at the Omaha Exposition. The contract for the work was signed the day the Paris Exposition opened. Lumber is very dear in France, and there will be 75,000,000 feet available after the close of the Exposition.

An interesting collection of weapons is to be seen in the building devoted to forestry and chase. A number of cases contain weapons sent by the Czar and those which belonged to Prince Eugene, lent by the Duke of Leuchtenberg. A gun which belonged to the Czar Paul I. is to be seen, and the sword which Napoleon wore at Tilsit, and which he presented to the Emperor Alexander. A number of pistols of different kinds and fowling pieces which belonged to the Princess Elizabeth, also a pistol belonging to Henri III. of France, are shown. The Imperial Treasury of Moscow has loaned a sword which was given by the City of Paris in 1814 to General Osten-Sacken, who was governor at that time. Prince Lwoff has loaned a sword which was worn by the Emperor Napoleon, bearing the date 1806; it is richly ornamented. The arms of the Prince Eugene de Beauhamais are shown, among which is a sword worn while Viceroy of Italy and another worn as Prince of France. The cross-bow which belonged to the Queen Marie de Leczinska has a barrel in steel, damascened and inlaid with gold. Among other objects are a single-barreled gun of the time of Louis XV., and a number of gems and pistols of the eighteenth century, besides a collection of sabers and swords dating from 1791 to the present time.

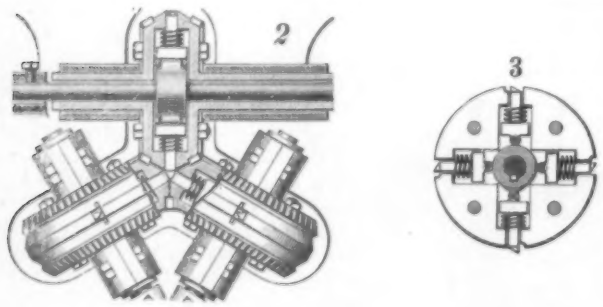
The number of entries to the Exposition has been steadily increasing ever since the official opening, but at no time has the crowd of visitors been so large as that of Sunday, May 27, when a total of 406,196 persons passed through the entry gates, 52,131 of these being non-paying; at 10 o'clock in the morning the circulation in certain places had become difficult, and in the afternoon the crowd was greatly increased in the Champ de Mars, the Rue des Nations and the Invalides. The spectacle, when viewed from the height of the Trocadéro Palace, is interesting and novel; the weather was fine, and it is evident that the Exposition is beginning to attract a large part of the public. At certain times the crowds at the entrance gates were such that special measures had to be taken to avoid accident; a number of police agents were stationed at each passageway to regulate the traffic. The moving sidewalk was at times completely filled, and the stream of persons passing at a high elevation is one of the interesting sights of the exposition. The electric railway also carried a great number of passengers and is of great convenience in passing from one section of the grounds to another as but short time is employed to make the circuit. The palaces and pavilions have never before received such a number of visitors; the various buildings of the Exposition are practically completed, and many of the national pavilions are already open to the public. In the main buildings of the Champ de Mars, a great number of the exhibits have been completed, and the others are making rapid progress.

The Army and Navy Building, which is situated on the banks of the Seine, contains a number of interesting exhibits. Among the principal exhibits may be mentioned a collection of Hotchkiss rapid-firing guns of different types, with a number of projectiles. The Mangin Company show a number of arc projectors for marine use; and the Clamond Steel Works has a collection of field cannon and ammunition wagons. An interesting exhibit is that of a number of stuffed horses and mules attached to ammunition wagons, showing the system used in the French army. The Dubos Company has a new system of diving suits and appliances. A number of fine models of French boats are to be seen here; these are exhibited by the different dock and naval construction companies. Some of them have been furnished by the Société des Chantiers de la Gironde, who show a model of the "Kleber" and the method of boat-construction; the firm of August Normand, of Havre, have a series of models of cruisers, among which may be mentioned the "Azuma," built for the Japanese government, and the "Massena" and "Guichen," of the French navy. A number of automobiles for military use have been already installed. Among these is a heavy transportation wagon of the Scotte system, having a steam engine mounted in the forward part, the rear being arranged to carry freight; another large freight wagon is that constructed by the De Dion Company, using the gasoline system. A number of light automobiles are to be seen; one of these is for the officer's use, and another for the military postal service.

A NOVEL NAIL-FORMING MACHINE.

An ingenious apparatus for rolling nails from a continuous length of stock has been devised by Mr. Sextus L. Reed, P. O. Box 31, Gallatin, Tenn., which apparatus is designed especially to produce a triangular nail, although other forms can also be made. The features of novelty in the invention are to be found in the means for cutting the stock into lengths and for forming the points and heads. Fig. 1 is a general perspective view of the machine; Fig. 2 is a sectional elevation; and Fig. 3 is a section showing the cutting devices.

The machine includes in its construction a substantial frame on which is mounted a driving-shaft, actuated at one end by a pulley, and provided at the other end with a pinion, engaging a spur-gear, rigidly secured to a hollow shaft formed in two sections. Two additional hollow shafts are also employed, each of which is likewise formed in two sections. The three hollow shafts are triangularly arranged and carry dies, each comprising two circular side sections rigidly secured to the sections of the corresponding hollow shaft. Bolted between the side sections is an intermediate or face section of hardened steel, serving to roll the stock in conjunction with the intermediate or face sections of the other hollow shafts. Upon the side sections, it will be observed, are gear-teeth, meshing with those of a mating die and transmitting the motion received from the driving shaft first mentioned. The intermediate sections are formed with radial recesses which receive beveled, spring-controlled punches. The butt of each punch carries a roller which, as the die turns, travels over a stationary shaft provided with a cam and contained within the hollow shaft of the die. As the die rotates, it is evident that the punches will be periodically projected to cut the stock, and automatically returned by their springs. The side sections of the dies, at the outer ends of the radial recesses, are formed with transverse openings into which the stock is pressed to form the triangular head of the nail, the beveled ends of the punches serving to produce the points. Any desired number of punches may be used; but in the machine illustrated, four punches are provided for each die, so that four nails are formed at each revolution. The dies are so arranged that, in turning, they cause the punches to register with one another. The cams are so disposed that three meeting punches (Fig. 2) are thrown out and made to sever the stock to form a nail. The meeting bevel ends of the punches produce the point of the nail. At the same time the stock is pressed into the transverse openings of the side sections to form the head. Each of these operations, of course, is performed on a different section of the stock, the nail having its point formed by one set of punches and its head in the set of punches immediately following. By changing



REED'S NAIL-FORMING MACHINE.

the form of the face or intermediate sections of the dies, nails of any desired shape can be made.

WE have already referred to the restoration of the Crystal Palace. The first portion of the work has been done, that is, the re-roofing. The transept which has been completed is 384 feet, long, has semi-circular spans of 120 feet and the height from the floor to the central point is 170 feet. The original form of the roof, that is, of the ridges and furrows, designed to resist the attacks of hail storms, has been preserved.

ELECTROENGRAVING.

It is only within recent years that mechanical processes have been devised which have very considerably simplified the work of producing engravings. And of all mechanical means of making plates, that of embossing

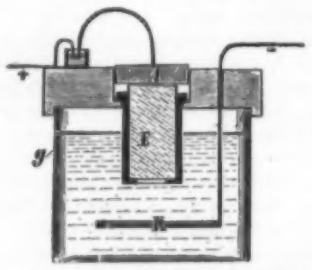


Fig. 1.—DIAGRAM OF BATTERY AND PLASTER CAST.

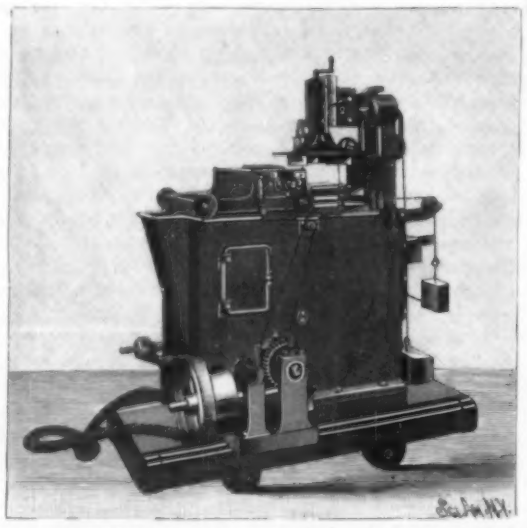


Fig. 2.—AUTOMATIC MACHINE FOR CLEANING THE PLATE.

or stamping is the most important. But in order to produce a steel plate by the process of embossing, a die is necessary which must be laboriously cut by hand. Casting and electroplating have been resorted to, in order to reduce hand-labor; but the results have been so exceedingly poor, that the art of a skilled craftsman has ever been required to engrave the wrought or rolled steel dies. With the object of accomplishing results which could not be attained by casting or electroplating and of performing mechanically much of the work which has hitherto been done only by hand, Herr Josef Rieder, a German inventor, has devised a process which he terms "electroengraving."

In electroengraving an electrochemical etching agent is employed. If two steel plates be plunged in a solution of ammonium chloride, and the one plate connected with the positive pole, the other plate with the negative pole of a source of electricity, iron will be eaten from the positive plate, and will form a solution of iron chloride, from which iron is again precipitated upon the negative plate. If parts of the positive plate be covered with shellac, only the unprotected portions will be eaten away, and thus a pattern will be produced. This process of etching has long been known and has been applied in the arts. But it has been applied only to plane surfaces, and not to such plastic forms as reliefs. In electroengraving, on the other hand, the plate is not covered; but, nevertheless, means are employed for bringing the solution into contact only with the desired portions of the plate.

The most approved form of apparatus at present in use consists of a glass vessel, *g*, provided with a cover having a central aperture flanged to hold a rubber cup, the bottom of which is perforated. Within the rubber cup a plaster of paris form is held, upon which the design to be reproduced has been cast. Upon the upper or modeled surface of the form a steel plate, *A*, rests, which snugly fits the aperture in the cover of the vessel, so that it cannot be laterally displaced. The vessel, *g*, contains a solution of ammonium chloride in which is plunged a steel plate, *K*, connected with the negative pole of a source of electricity and constituting the cathode. The steel plate, *A*, is connected with the positive pole and constitutes the anode. The ammonium chloride is absorbed by the plaster form, *E*, so that the steel plate, *A*, is practically in contact with the solution. When the circuit is completed, chlorine is released at the anode, which, combining with the iron, forms a solution of iron chloride. The anode is gradually eaten away, so that new points of the metal come into contact with the plaster cast. The process is completed when all parts of the anode have been acted upon by the plaster cast. With this apparatus the inventor found it necessary to remove the steel-plate, *A*, at intervals of 20 seconds, to clean it with gum water and to brush fresh ammonium chloride upon the relief surface of the plaster cast.

The inventor attained good results with this apparatus. But evidently the constant cleaning by hand was a process too laborious for the practical utilization of the inventon. A machine was, therefore, devised, the function of which was to accomplish automatically what was formerly effected by hand.

After various improvements and modifications this machine finally took the form shown in the second of our illustrations. The plaster casts (several are employed in the practical application of the invention) are held by means of two screws upon a vertically movable table, which receives its motion from an eccentric. Above this metallic table is an adjustable holder in which the plate to be etched is mounted. Behind the table is a carriage with a rotary brush, which is also driven by eccentrics, and which is adapted to pass between the plaster cast and the plate, in order to remove the refuse from the eaten steel. Water is supplied to the brush by a perforated pipe. Above the cast a sponge roller is mounted which distributes fresh solution over the relief surface.

The plaster cast is brought into contact with the plate by means of the movable table, for a period of 15 seconds, then returns, and permits the cleansing apparatus to operate. When the cleaning carriage has returned to its normal position, the table again brings the cast into engagement with the plate, these operations being repeated until the plate is completely etched. It is particularly important that the cast be brought into contact with the plate as gently as possible; nevertheless, it is impossible to protect the cast when but a single point touches the plate. To preserve the cast the inventor employs a safety device which relieves the single point of the pressure so far as possible. The machine is provided with an arrangement for casting plaster forms to take the place of those which have been worn away.

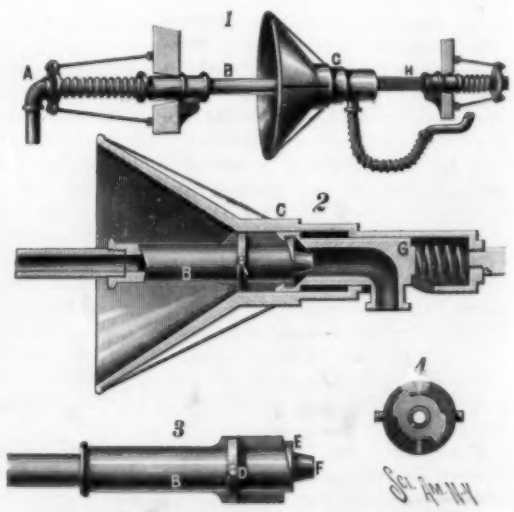
A current of 12 to 15 volts pressure is used. The current strength is automatically regulated to conform with the area of the contacting surfaces, and for plates 200 × 300 mm. (8 × 12 inches) can attain a maximum of 50 amperes.

AN AUTOMATIC COUPLING FOR AIR-BRAKES.

The illustrations presented herewith, picture a coupling invented by Thomas H. Patching, of Strathfield, and Robert H. Finch, of Burwood, New South Wales, whereby the air-brakes of a train can be connected and disconnected automatically.

The device comprises a right and left part. The left part, *A*, consists of a round tube, *B*, passing through the sole-plate of the car, and supported by a bracket in which it moves freely. The tube, *B*, furthermore passes through a collar attached to the sole-plate, and is surrounded by a strong coiled spring, which serves to keep the left part pressed forward into position, and permits backward and forward play of the cars.

The right portion comprises a square metal bar, *H*,



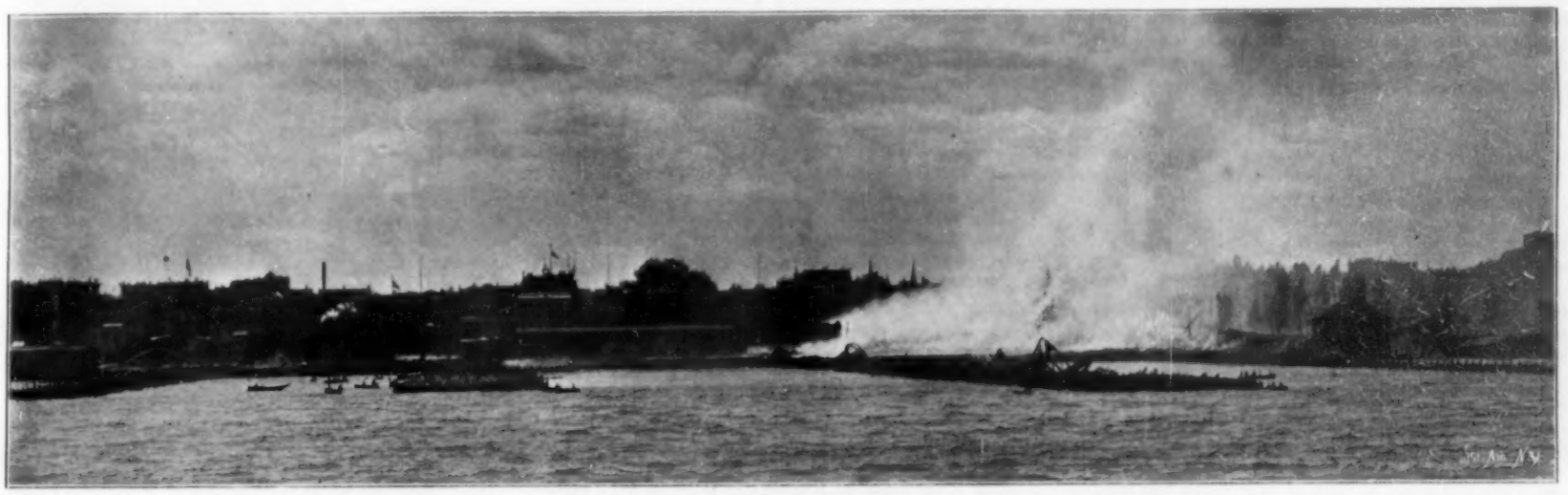
SELF ACTING COUPLING FOR AIR-BRAKES.

passing through the sole-plate of the car and provided with supports and springs similar to those of the left portion. The right portion is provided with a funnel-shaped orifice and an air-pipe (Fig. 1).

As shown in Fig. 2, the tube, *B*, carries a hollow cylinder ending in a nozzel. On the cylinder are two gripping lugs, *E*, one of which is shown in Fig. 3 and both in Fig. 4, and two longitudinal guide pieces. On either side of the cylinder a pin, *D*, projects. Within the right part are two cylinders of unequal diameter, thus forming a shoulder. The larger cylinder is provided with two helical openings to engage the pins, *D*. In the smaller of these cylinders slides a spring-pressed, hollow piston, *B*, having an air-pipe connection which is designed to engage a left-handed helical

opening in the smaller cylinder. Attached to the air-pipe connection are two lugs which are adapted to lock with the lugs, *E*, on the left part.

When two cars are brought together, the left part enters the orifice of the right part which is funnel-shaped to insure the entry should the cars be unequally laden or located on a curve. The horizontal cross-pins, *D*, enter the helical slots provided for them; and at the same time the nozzel at the end of the tube, *B*, enters the hollow piston, *G*. The continued pressure of the two cars causes the cross-pins, *D*, to travel along their helical slots, causing the left part to rotate in one direction, while the forward pressure of the left part forces the sliding piston back, carries the air-pipe connection previously referred to along its left-handed helical opening, so that the piston, *G*, is caused to rotate in an opposite direction. These two opposite rotary movements force the lugs, *E*, under the grips on the air-pipe connection, thus forming a tight joint. The mere acts of separating the cars, causes the movable parts to rotate in the reverse direction to uncouple the pipes.



REMAINS OF THE FOUR NORTH GERMAN LLOYD PIERS AFTER THE FIRE OF JUNE 30, 1900.

THE BURNING OF THE NORTH GERMAN LLOYD STEAMSHIPS AND DOCKS, HOBOKEN, N. J.

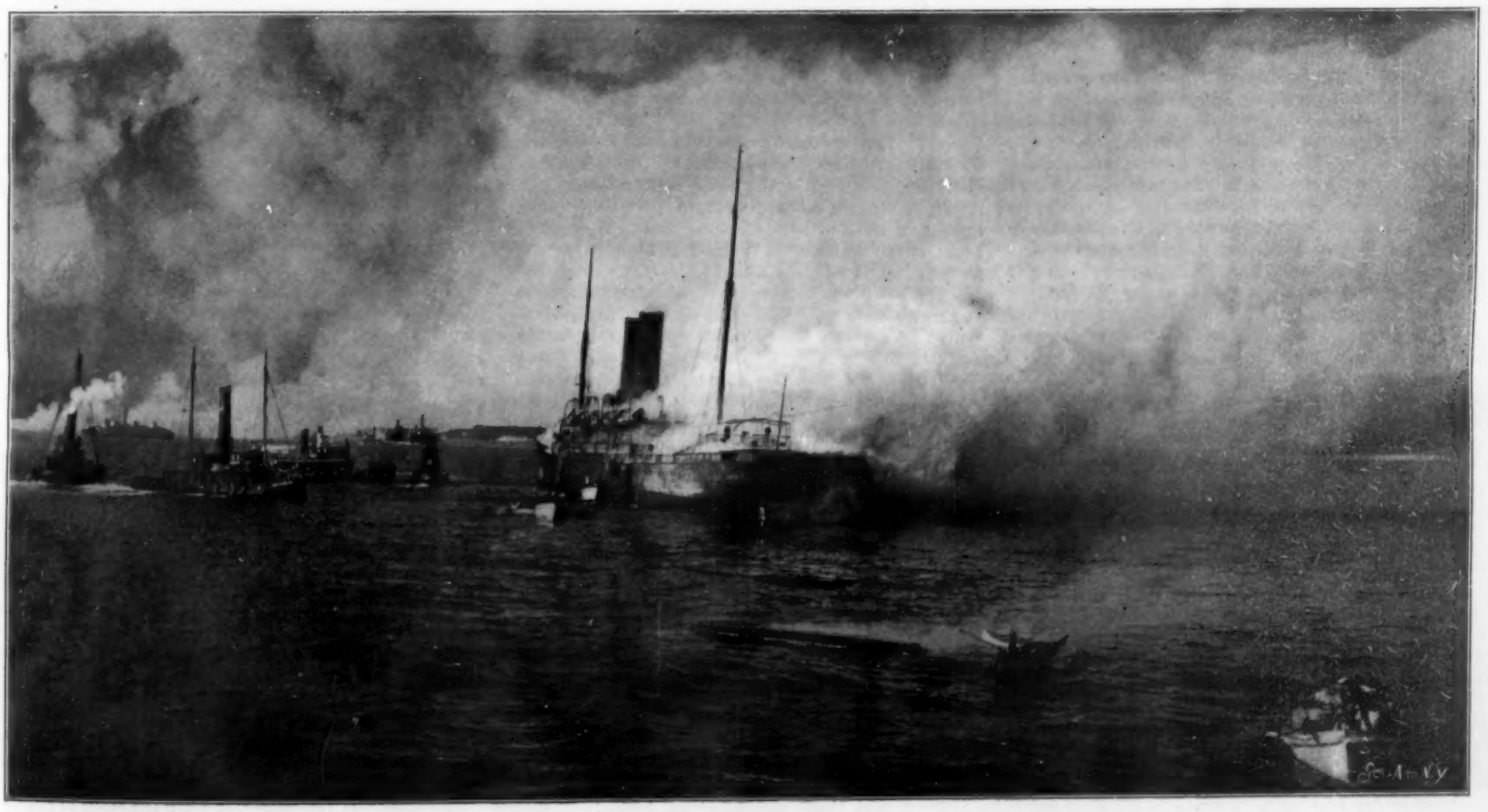
The record of disasters from fire in New York contains nothing more terrible than the conflagration which occurred on the afternoon of Saturday, June 30, by which between three hundred and four hundred lives were lost, many of them amid circumstances of unspeakable horror, while three of the largest steamships, of the North German Lloyd Company, and the four piers which constitute the landing facilities of the company at this port, were destroyed.

The docks of this great company, which together with those of its rival, the Hamburg-American line, are located on the New Jersey shore of the North River, at Hoboken, consisted of four large piers carried upon piling. The largest of these was a new double-deck structure, only recently completed, while the others had been more or less renovated, and in one case considerably lengthened. Most of them were of the standard type of construction, which, unfortunately, in the light of the recent disaster, is used almost exclusively on the water front of New York harbor. Piling is driven over the whole area to be covered by the piers and capped with 12 by 12 timbers, upon which are laid the joists and wooden flooring. The sheds on the majority of the older piers are built with wooden posts and roof trusses, and are wood sheathed.

At the time of the outbreak of the fire, which, according to eye-witnesses, started about five minutes to four on the afternoon of June 30, the situation at these docks was as follows: To the north was the new pier, about 800 feet in length, recently completed by the company, and generally known as the Thingvalla pier. On the south side of it was lying the steamship "Main," a new vessel of 6,398 tons, recently constructed by Blohm & Voss, of Hamburg, which came to New York on her maiden trip only last April, and on this fatal afternoon was loading for her second return voyage across the Atlantic. She had accommodations for 300 cabin and 800 steerage passengers, and was in every respect a first-class ship. Next to the steamship "Main" was pier number 1, with the steamer "Bremen" lying to the north of it, and the celebrated "Kaiser Wilhelm der Grosse" moored on its south side. The "Bremen," built in 1896 by Schichau in Germany, was one of four huge vessels constructed to carry a large quantity of cargo and a considerable number of passengers. She was 500 feet in length, 60 feet in beam, and had a register of 10,000 tons, and a speed of 15 knots. The "Kaiser Wilhelm der Grosse" is to-day the fastest of the great ocean liners, and one of the most popular passenger vessels afloat. She holds the eastward record to Southampton of five days seventeen hours and eight minutes, and a westward record of five days twenty hours and ten minutes. She is 648 feet in length, 66 feet in beam, and has a displacement of 20,000 tons. With a horse power of 27,000, she has a record speed across the Atlantic of over 22½ knots an hour.

The next pier to the south, Number 2, was accommodating the steamer, "Saale" of 5,267 tons register, one of the older vessels of the Company, which was constructed in 1886 at Glasgow. She is 455 feet in length and 48 feet in beam, and was known as one of the popular vessels of the line. Only a few hours before the disaster the steamer "Aller" had sailed from her birth between piers Nos. 2 and 3. At pier No. 3 there were several lighters and barges. It should be mentioned that all of these steamers had coal barges and canal boats alongside, from which they were taking coal and cargo, in preparation for the return trip across the ocean.

It seems that on the fatal afternoon there was lying in the middle of pier No. 3 a large quantity of cotton bales, and it is said that not far from this were over a hundred barrels of whiskey. It is generally agreed that the fire originated in the cotton, and it is supposed that the extraordinary rapidity with which it spread was due to the explosion of the whiskey and the scattering of the inflammable contents over the cotton. Be this as it may, it is certain that the fire swept through the whole length of the pier with extraordinary rapidity. It is stated by a captain of a tugboat, that although he was only a quarter of a mile from the pier when the smoke first appeared and made all haste across the river, the structure was wrapped in fire from end to end by the time he reached it. The spread of the fire was greatly accelerated by a strong westerly wind, and it is stated by eye-witnesses that within nine minutes from the time the first blaze was seen, the whole



THE "SAALE" BURNING IN MIDSTREAM AFTER DRIFTING OUT FROM THE BURNING DOCKS.

four piers and the steamships adjoining were ablaze. So swiftly did the flames leap from pier to pier, and to the adjoining ships, that within a few minutes the "Main," "Bremen," "Saale," and even the great "Kaiser Wilhelm der Grosse" were afire. On account of her extreme value, the efforts of the tugboats that rushed to give assistance were directed principally to saving the "Kaiser Wilhelm der Grosse," and, although she was dragged out into the midstream with her upper works ablaze, the fire was got under control before very serious damage was done. Not so, however, with the other vessels. Although the moorings had been immediately cast adrift by the crew when the fire started, the concentration of effort on the "Kaiser Wilhelm der Grosse" and the efforts of the tugs to save the people who had leaped from the burning piers into the water, resulted in these three vessels being left to the mercy of the fire, until, under the action of the tide, two of them, the "Bremen" and the "Saale," drifted out, blazing from stem to stern, into the Hudson River. The "Main" was burned at her dock.

While the loss of property was enormous, the magnitude of the disaster is to be measured by the awful loss of life and the aggravated horrors that attended it. Scattered over the ships, the piers, and the lighters were the crews and longshoremen, busy at the work of loading; and the spread of the fire was so sudden that escape from the piers to the shore was impossible. As a consequence, the majority of those who were cut off from escape by land leaped into the water, many of them being drowned before they could be picked up; but even this relatively merciful form of death was denied to many unfortunates who were working in the holds and lower decks of the vessels, and only discovered what was going on when they found their escape through the hatches cut off by a sea of fire which was raging in the upper works. Many of these were doubtless suffocated by smoke or burned as the vessels sank under the streams of water which were being poured into them from the fireboats and tugs. A feature which rendered the disaster particularly horrible was the fact that many of the imprisoned people could have been rescued had the portholes of the "Saale" been a few inches larger than they were. As it was, many victims died before the eyes and within actual touch of would-be rescuers, who were quite powerless to help them.

Within a couple of hours the whole four docks of the North German Lloyd Company and their warehouses were completely destroyed, and three of the passenger steamers were so far burned that it is as yet questionable, in the case of some of them, whether they will be worth refitting. The total loss of the company, including cargoes, is estimated by the general agent of the line to be about $5,000,000, while the present indications are that between three and four hundred souls perished. Of our illustrations, one shows the "Saale" when the fire was at its height. It was taken shortly after the vessel had drifted out from her pier into the river. The other photograph shows the present appearance of the water front, which was formerly occupied by the piers and the sheds of the company.

Geology and Geography at the Forty-ninth Meeting of the American Association for the Advancement of Science.

BY E. O. HOVEY.

According to the plan always followed at the annual conventions of the American Association for the Advancement of Science, practically the whole of the first day's session of Section E, that of geology and geography, was given up to the summer meeting of the Geological Society of America. The number of papers presented to the two bodies was unusually small this year, only ten being read before the Geological Society and seventeen before Section E, aside from the vice-presidential address of Prof. Kemp, an abstract of which has already been given in the SCIENTIFIC AMERICAN SUPPLEMENT. The attendance of active geologists at these summer meetings was rather small, on account of so many of them being engaged in field work, but it was representative, geographically, including as it did men from many of the States from Maine to California, and from Canada.

The meeting of the Geological Society of America was called to order in the geological lecture room of Columbia University, Tuesday, June 26, with the president, Dr. G. M. Dawson, director of the geological survey of Canada, in the chair. The secretary announced the election to fellowship of L. C. Glenn, of the North Carolina survey, T. L. Watson, of the Georgia survey, and Stewart Weller, of Chicago University. The secretary further stated that the next winter meeting of the society would be held in Albany, N. Y., and then the society proceeded to the hearing of the papers.

The first on its programme was by H. W. Turner, of the United States Geological Survey, and was entitled, "The Geology of the Silver Peak District, Nevada." This district lies in Esmeralda County, in the western edge of the Great Basin, and is characterized by isolated ridges and wide valleys. The lower portion of the valleys are playas or dry lake beds. The playas are often covered with incrustations of salt and much of the mineral is sufficiently pure to be used for domestic purposes without refining it. Some of the playas, however, like the Columbus playa and one in Fish Lake Valley, are rich in borax salt. The oldest rocks, except some gneisses of doubtful age, are Lower Cambrian. The middle Cambrian and the Ordovician strata are also represented, but then there is a great break to the tertiary beds. Volcanic activity began in Paleozoic time, and, after a long interval of rest, was renewed in Tertiary times, when a lake covered a large part of the district and deposited several thousand feet of strata. The chief economic interest in the region centers in the gold and silver veins in Mineral Ridge, an east spur of the Silver Peak Range. These veins occur usually at the contact of the granite and gneiss with the overlying Cambrian rocks and are of two kinds, quartz veins containing, for the most part, pyrite and free gold with a little silver, and quartz veins, which contain lead sulphides and silver, with a comparatively small amount of gold.

Erasmus Haworth, of Kansas University, presented a paper on "Native Copper from Garfield County" (Oklahoma). The native copper occurs in thin leaves in the "Red Beds," at a depth of about 32 feet from the surface of the ground. They seem to be confined to a stratum of red clayey shale six inches thick, and lie therein at all angles to the bedding, approaching parallelism thereto near the middle of the bed. They occupy fissures due to the drying of the beds, and are, therefore, of later date than the deposition of the beds themselves. The beds are utterly destitute of fossil remains, so that the reduction of the metal can hardly be ascribed to the action of organic matter. Furthermore, the rock is entirely unaltered, and the nearest igneous masses are at least one hundred miles distant. The author refers the native copper, therefore, to a possible chemical reaction between copper sulphate, iron oxide, and calcium carbonate, with traces of free sulphuric acid.

C. H. Hitchcock, of Dartmouth College, in a paper on the "Evidences of Interglacial Deposits in the Connecticut Valley," reported that he had found eskers and other glacial deposits in such relations to the earlier glacial beds near Hanover, N. H., as to convince him that there had been at least two advances of the great ice sheet over the region.

A second paper by Prof. Hitchcock described some of the volcanic phenomena connected with the eruption of Mauna Loa, on the island of Hawaii, in 1899. The first indication of activity was seen on the morning of July 4. It was the reflection in the sky of the light from the molten lava in the great pit 14,000 feet above sea level. A day later the first outbreak began with an explosion, about 3,000 feet below the summit on the eastern side. The melted lava discharged itself in a column thought by some to be 500 feet high at first. The material falling to the ground around the vent gave rise to the formation of a cone. Later a second vent discharged a similar flood half a mile from the first opening and not far from 10,000 feet above the ocean. Both these discharges were clearly visible from the Volcano House, near Kilauea, twenty miles away. Clotted lava blocks of considerable size and stones were freely emitted from these vents, while the lava flow followed down the north side of the mountain for fifteen miles. In three weeks' time the flow ceased. The stream was eighty feet wide and ten feet deep at its start, but was a mile wide lower down. The place of discharge was just above the upper limit of the northeast trade winds, consequently the column of steam and dust ascended vertically and spread out laterally, like the trunk and foliage of a large tree. The fine particles of dust spread in all directions and obscured the sky for a thousand miles on every side. At Honolulu, 150 miles distant, people could feel the impact of the particles on their faces. Old beds of ashes on the island indicate previous explosive activity at both Mauna Loa and Kilauea. Their decomposition has furnished the soil for the forests and now for the sugar plantations. The Hawaiian volcanoes were active in Tertiary time. On Oahu different sections are classified by the amount of erosion effected since the basaltic outflows. Mauna Loa shows no marks of erosion. It is a gigantic basaltic dome, which has required millions of years for its formation, judging from the comparatively small quantity of lava discharged in the present century.

W. H. Hobbs, of the University of Wisconsin, presented and discussed "A Theory of the Origin of Systems of nearly Vertical Faults, with Application to the Newark Basin of the Pomperaug River (Conn.)." This was related to an elaborate paper presented to the Society at its meeting last winter. He finds that the rocks of the region have been broken into rhombic prisms standing on end. The author thinks that the numerous faults are due to dislocation along joint planes and relief from pressure horizontally applied and that the superposed load must have been comparatively small.

Rudolf Ruedemann, of the New York State palæontological survey, delivered a paper on the Hudson River beds of the vicinity of Albany, in which he showed that these strata, which have been rather neglected by geologists on account of their paucity of fossils, are not to be regarded as representing one age. On the contrary, they contain beds belonging to several horizons. The other four papers on the society's programme were read by title.

One of the papers of most popular interest delivered before Section E was that by F. H. Newell, hydrographer of the United States Geological Survey, upon the progress being made in the measurement of streams and determination of the water supply of the country.

He showed that the water resources are being studied in a manner comparable with that in which the metals and ores are being examined, and official data collected concerning the occurrence and value of this important natural product.

On important streams in various parts of the United States systematic measurements are being made showing the variations in discharge from day to day throughout several seasons and years; in this manner the quantity and time of occurrence of flood is made known and the duration of seasons of drought. By having this information engineers and others concerned in the development of water power can determine the degree of reliability of various streams, and ascertain the available power.

Not only are the surface streams being measured, but examinations are being carried on of the occurrence of water underground, especially that reached by deep artesian wells. The importance to the public health of a water supply from these sources is well known. Applications are received from all parts of the United States for definite facts concerning the quantity and quality of waters occurring in pervious strata far underground. Throughout much of the United States the only mineral of economic value is water. This is particularly the case on the High Plains west of the Missouri River, where settlement is dependent wholly upon the ability to obtain water by the means of wells.

The subject of water storage is also being considered by the United States Geological Survey, and reservoir sites are being selected and surveyed in various parts of the West, particularly in the Rocky Mountain region, and in the high Sierras of California. Detailed surveys are made and estimates prepared of the cost of construction.

In the State of New York about twenty rivers are being measured—these being mainly tributaries to the upper Hudson, Mohawk and Black Rivers. Characteristic fluctuations of these streams were exhibited by means of diagrams. The catchment area tributary to various reservoir sites is being surveyed and shown upon the contoured maps prepared in coöperation with the State engineer and surveyor.

The information obtained concerning the flow of streams and the possibility of regulating the floods by means of storage reservoirs has peculiar importance in New York State, through the rapid development of electrical plants and the probable need of increased supply for the Erie Canal. The subject of the influence of forests upon the water supply can be thoroughly understood only when definite knowledge is had of the behavior of the streams. For this reason rivers issuing from the Adirondacks are being carefully studied, while the character of the timber on the watershed is being examined by foresters.

Another paper, the narrative portion of which will be read with widespread interest when it appears in the Century Magazine, was that by R. T. Hill, of the United States Geological Survey, describing the great "Chisos Rift" in Texas and the author's dangerous and thrilling journey down the wonderful cañons of the Rio Grande. This stream receives practically no tributaries for several hundred miles of its course and has carved its way through Cretaceous strata of different kinds, leaving vertical and even overhanging walls, hundreds of feet in height, turning sharp corners and giving surprises in the shape of rapids in the most bewildering manner. One of the cañons has received the suggestive name of Murderer's Cañon, on account of fatal encounters with Mexicans at its entrance. This paper, like many others on the programme, was elaborately illustrated with stereopticon views.

Prof. Hitchcock's paper, on the "Ice Age in New Zealand," gave the section a brief resumé of the observations he was able to make a year or more ago. The glaciers now existing among the high mountains of the Middle Island are the remnants or descendants of those of the great ice age. All were of Alpine character and were not continental like those of northern Europe and North America. The present glaciers have an average length and area at least 10 per cent greater than the existing glaciers of Switzerland, but they do not cover more than 30 per cent of the area occupied by ice at the maximum of the glacial epoch. The Tasman glacier is 20 miles long and 2 miles wide. The deposits of the glacial epoch in New Zealand are characterized by a general absence of ground moraine, eskers and drumlins, and there are very few large erratics. The lower portions of the subglacial streams spread cobble stones over wide areas. The great glacial epoch was in Tertiary time, according to the New Zealand geologists, who base their determination upon the stage of decomposition of the gravel and the association of the glacial

deposits with beds known to belong to the Tertiary. There are thirteen fjords on the southwestern side of the island, the topography is very rough, and the scenery is equal or superior to that of the Yosemite region in California.

John M. Clarke, State paleontologist of New York, brought out by means of diagrams and cross-sections the lenticular character of the Oriskany sandstone deposits in this State and showed how they filled depressions in the water-worn, but nearly level, Helderbergian rocks beneath. In some of the cement quarries near Buffalo the Oriskany sands are exposed, filling water-worn joints in the cement rock.

In the paper of A. A. Julien, of Columbia University, on the Genesis of the pegmatite in North Carolina, it was held that the origin of this rock has not yet been satisfactorily explained, and that the difficulty may be in part due to variation of conditions in the genesis of the aqueo-igneous magma. This is the rock which has furnished so many rare minerals to cabinets all over the world and is the source of some of the substances used in the making of mantles for incandescent gas lamps. Three hypotheses regarding its origin are in common acceptation, viz.: intrusion as dikes, infiltration as veins, and segregation. When examined, in view of the known characteristics of each of these forms, most of the pegmatites of North Carolina do not appear to conform to any one. In the author's opinion, they should be considered as aggregates of the very schist material which incloses them, softened to a plastic condition by thermal or superheated waters, and afterward consolidated with the concretionary structures which they now present. The phases of concentration of the more basic minerals (mica and feldspar) were discussed and note made of the significance of their close association with smoky quartz. The pegmatites of the region seem to mark the initial metastatic changes which accompany the birth of granite, rather than, as in some other regions, the phenomena which indicate the exhaustion of the process.

W. H. Hobbs, of the University of Wisconsin, described two rivers in western Connecticut in respect to the history of their drainage. They both have the same name, Still River, though they are only twenty-five miles apart. Both flow northward and one empties into the Farmington River, while the other empties into the Housatonic. Before the glacial epoch they flowed southward, but dams of gravel left by the great ice sheet changed their course to that which they have at present. R. D. Salisbury, of the University of Chicago, discussed at some length the yellow loam which occurs as a surface formation over a large part of New Jersey and adjoining States and which he has found to cover all strata from the most ancient rocks to the latest glacial beds with a thin mantle which is evidently a still water deposit. Prof. Salisbury holds that this is a marine deposit and that it indicates a subsidence of the region of not less than 240 feet since the retreat of the ice sheet and a subsequent elevation of a corresponding amount.

Papers were also read by W. J. McGee, on "The Occurrence of the Pensauken (?) Formation in the District of Columbia"; by D. S. Martin, on "The Geology of Central South Carolina"; by J. M. Clarke, on "The Fauna of the Arenaceous Lower Devonic of Aroostook County, Maine"; by J. P. Smith, on "The Principles of Paleontologic Correlation"; and by E. B. Mathews, on "A Simple Modeling machine."

The officers of the section for the next meeting, which takes place at Denver, are: chairman, Prof. C. R. Van Hise, and secretary, Prof. R. A. F. Penrose, Jr.

A TERRIBLE explosion occurred some days ago upon the premises of a large firm of manufacturing chemists in Huddersfield (England), when a large quantity of lyddite which was in process of manufacture for the government blew up with a tremendous report. The accident fortunately did not occur in the main portion of the factory, but in one of the out-lying buildings, and was separated from the main works by a river; otherwise the loss of life would have been appalling. The lyddite was undergoing the steam-drying process when it suddenly ignited through, it is believed, a spark from the chisel of a mechanic. The man lost his presence of mind, and instead of smothering out the fire with his cap, which he could easily have done, he ran away, probably thinking that the substance would explode. The explosive burned fiercely, and set fire to the building. Presently the roof of the structure collapsed upon the burning mass and compressed the gases. Consequently in a very few seconds there was a terrific explosion. The building was absolutely demolished, scarcely one brick being left upon another. Windows in the town were broken wholesale by the force of the concussion, and the débris hurled for a considerable distance in every direction. Fortunately there were few injuries to individuals, since all the workpeople had had ample time to clear out of the building. Only two hours previous to the catastrophe, it is said that 25 tons of lyddite had been removed from the very building in which the explosion occurred, so that it may be truly said that the inhabitants of Huddersfield had a very narrow escape from destruction.

Science Notes.

A fisheries exhibition will be held at Salzburg, Austria, on September 2.

The shipping of monazite from Brazil to Europe has almost been discontinued, owing to the very low price paid. The cheapness of the sand is one of the causes of the inexpensiveness of the German mantles.

A cylindrical slide rule has been devised by Prof. Robert H. Smith. By means of a spiral on the cylinder a length of over four feet is obtained for the logarithmic scale, which enables great accuracy to be obtained.

A school of practical agriculture has been opened at Briarcliff Manor on the New York and Putnam Division of the New York Central Railroad. The aim will be to raise the standard of agricultural methods, and practical instruction will be given in the orchard, garden, greenhouse, poultry yard and dairy. The idea is to consider first the quality and afterward the quantity of the article produced.

Meager accounts have been received of the trials of Count Zeppelin's airship which took place at Friedrichshafen on the evening of July 2. At a height of 1,200 feet the airship traveled 5¼ miles in seventeen and a half minutes, presumably with the assistance of the wind. There were five in the car. The apparatus for ascending and steering answered admirably until a rope became twisted in the gear which caused an abrupt end to the trip. The airship was fully described in the SCIENTIFIC AMERICAN for May 26, 1900.

The Académie des Sciences has lately received a communication from La Paz, Bolivia, relating to a remarkable meteorite which fell near that city. It was observed on November 20, 1899, at 7 h. 24 m. by a clear and starry night, the moon not being visible. According to the observers which were stationed on the hill of St. Sebastian, a short distance from the town of Coronilla, the meteor passed in a straight line from southwest to southeast during five or six seconds, over one-third of the visible horizon. It had the form of an immense disk of a reddish white color, with a train of bluish light; it exploded near the town of Pazedon and projected a number of meteorites upon theground.

The so-called horse-sickness which is endemic in the Orange River Colony, Transvaal, Natal, Rhodesia, and Bechuanaland, and occasionally in Cape Colony, is getting to be very serious and efforts are being made to render the horses immune. Fortified serum derived from immune horses almost invariably produces fatal results when injected into horses suffering from horse-sickness. The fortified serum is a useful agent if properly used, and is capable of preventing the onset of horse-sickness. Judicious treatment with the serum will assist in bringing about a cure, for if the animal is gradually accustomed to the toxin until it can receive an injection of 100 to 200 cc. of serum, virulent blood can be injected without danger.

In some circumstances a liquid which will not freeze is needed, among others, for certain forms of brakes, especially those used for pieces of artillery. For this purpose glycerine has been used extensively, but is somewhat costly, and alcohol even more so. These liquids may be replaced to advantage by a solution of chloride of calcium of 28 per cent strength, its cost being almost negligible. The solution will support a temperature of —32° C. without apparent change, and does not attack metals. Another solution which has been recommended for this purpose contains, in 100 parts, 1 part of chloride of magnesium, 10 parts chloride of calcium, and 20 of chloride of aluminium.

In Berlin elaborate preparations are making for the exhaustive aeronautical and scientific research that is to be made on July 15. The balloon, which has been contructed by a continental firm, is the largest ever made, being of over 320,000 cubic feet capacity, or twice the size of that in which Andree set out for the North Pole. It is to carry 6¼ tons, with 3½ tons of ballast. It will ascend at the Sport Park, Friednau. The main object of the expedition is to ascertain how long it is possible for a balloon to remain floating in the air. For this purpose the aerial vessel will be well supplied with provisions, while it will also be equipped with sleeping accommodation for the benefit of the aeronauts. The balloon is also to be utilized, during its ascent for the purpose of making several meteorological observations.

A curious case was tried before the Civil Courts in Vienna the other day regarding a claim arising out of a railway accident. The plaintiff stated that he had received internal injuries as the result of the accident. The medical experts maintained that the shock of the smash had caused the heart of the plaintiff to change from its normal position, to one lower down in his body. This theory was received with incredulity by the jury, but their sceptism was satisfied when they applied their hands to the man's ribs and could feel the organ beating in the usual manner. The medical men stated that the sufferer might live for several years notwithstanding the extraordinary displacement of his heart, but that he was more liable to heart failure and would experience great difficulty in doing his work. Under these circumstances the jury awarded the plaintiff heavy compensation.

Engineering Notes.

The city of Lafayette, Indiana, has presented to Purdue University a 2,000,000 gallon water works pumping engine for use in the laboratory of the University. It was built in 1875, and is an excellent example of the duplex walking beam pump. In addition to its historical value, it will furnish an ample supply of water for the hydraulic experiments which will be carried on.

M. Ende has recently compared the figures for the motive power used at the different expositions which have been held at Paris. In 1867 the total horse power was 854, furnished by 52 engines averaging 16 horse power each; in 1878 the total was 2,538 horse power, given by 41 engines of 62 horse power average. The figure for 1889 is 5,320 horse power; only 32 engines were used, with a mean of 166 horse power. In 1900 the total power of the engines and dynamos used to supply the energy is 36,085 horse power, supplied by 37 machines, giving a mean of 975 horse power. The French section has 18 machines, with a total of 14,435 horse power, or 802 per unit, and the foreign section supplies 19 machines, giving 21,650 horse power, or a mean of 1,140 per unit.

In the large sawmills of Joseph Fialla, in Austria, the sawdust is utilized by being made up into briquettes; these form a good combustible for boiler furnaces or household use. The sawdust is impregnated with a mixture of tarry substances and heated to the proper temperature; it is then passed over a plate of iron heated by steam, from which a screw conveyor takes it to the screw-press, where it is compressed into briquettes of the required size. The press turns out 19 per minute, weighing ¾ of a pound each and measuring 6×2¼×1½ inches. The calorific power is about the same as that of lignite, with but 4 per cent of ash. The factory turns out more than 6,000,000 briquettes a year; the cost is about 16 cents per thousand, and the selling price reaches one dollar, leaving a considerable margin of profit.

The development of the carbide of calcium industry in Europe is shown in the account recently published by the French Acetylene Syndicate, by which it appears that in 1896 there were but four carbide factories, of which two were in Switzerland, one in Germany and one in France. At present the total number of carbide works in France, either in operation or in course of construction, represents a nominal capacity of 50,000 horse power, this being furnished by hydraulic plants. In Germany this figure is 12,440; Italy has more than 16,000 horse power; England, on the other hand, has but 1,600; Norway has 15,000, Austria 18,550, Russia 3,500, of which 2,000 represents hydraulic power, and Switzerland 19,000 horse power. The full capacity of these plants is not entirely utilized as yet; thus, France which could produce 27,000 tons annually, gives but 15,000 to 20,000.

A new railroad is to be constructed in Belgium which will unite Brussels with Ghent; it forms the prolongation of the existing Ghent-Ostend line and is to be laid out with the most recent improvements. Its length will be about 30 miles. The new road will permit the distance from Brussels to the coast to be covered in 75 minutes; it will be operated at first by steam, but is constructed so that electric traction may be substituted later if desired. It will run in a nearly straight line from Ghent to the suburbs of Brussels, without grade crossings or intermediate stations. The construction of the road will not cost more than $100,000 per mile, and the 30 miles will thus cost below $3,000,000. A project has been recently under consideration for a direct line on the electric system from Brussels to Antwerp, in which the trains were to have a normal speed of 60 miles per hour without stops between the cities, but after considerable discussion it was decided to abandon the project for the present.

An Austrian journal, the Zeitschrift für Berg und Hutten Weisen, gives a number of figures relating to the mine disasters which have taken place during the last five years in the principal countries of the globe. During this period, Germany is the country which has suffered most from disasters of importance; the whole number of lives lost is more than 700, occasioned by 49 disasters; the list does not take into account single accidents. Of these the most fatal accidents have been caused by explosion of gas and by fire. Russia occupies the second place with 650 victims, including a single disaster which was caused by inundation, in which 300 lives were lost. America and England come next, the former with 395, the latter with 365; in the former case explosions have been the principal causes, and in the latter explosion and inundation. As the Austrian journal does not take into account accidents of less than 10 fatalities, there is no doubt that the list would be greatly increased. The next is Hungary, with 126; Spain, with 108; France, with 70; and Belgium, with 48. In France this number is due to 7 serious accidents, and deducting those of Monteeau-les-Mines and Rochebeile, in which 50 lives were lost, there remains but 20; it may be supposed that this number, relatively small, is due to the good working of the mining administration in that country and to the strict inspection which is exercised.

THE MANUFACTURE OF GUNS AND ARMOR AT THE BETHLEHEM STEEL WORKS.

III.—HARVEYIZED ARMOR.

The present article is devoted to a description of the manufacture of Harveyized armor plate, as this represents the most modern method of making armor that is open to public inspection, the secrets of the Krupp process being still jealously guarded in every country where Krupp armor is made.

One of the early steps in the process is the casting of the open hearth ingot in a specially prepared mould. It is cast with a considerable excess of metal at the top, known as the "sinking head," which, as explained in a previous article, serves the double purpose of supplying molten metal to run down and fill the cavities which would otherwise be formed in the heart of the ingot in cooling, and of affording a convenient handle, as it were, by which the enormous mass of metal may be lifted and generally manipulated during the process of forging. The excess of metal in an ingot over that to be found in the armor plate is greater than in any other large mass of metal product, on an average less than forty per cent of the original mass appearing in the finished marketable plate. Some of these ingots are truly enormous masses of metal, the largest of which weigh as much as 275,000 pounds. The particular ingot which is shown in our engravings in the process of being forged weighed more than 125 tons in the rough. It was cast for the front or port plate of the new battleship "Alabama," and by the time it had been worked down and machined to its finished state, less than 30 tons, or about 24 per cent of the original 125 tons, remained.

After casting, the ingot is cleaned and taken to the forge, where the upper end of it is placed in a massive cast-steel sleeve, from the other end of which projects a long steel bar, provided with a sliding balance-weight. The sleeve is supported in an endless sling chain, which is hung from a gear-controlled block, as shown in the engraving. The block in turn is carried at the lower end of a vertical shaft, which is suspended at its upper end from the trolley of a massive, overhead traveling crane. The ingot, sleeve, counter-balance bar, etc., will weigh, in the case of the heaviest work, in the neighborhood of 250 tons. After the ingot has been heated to a white heat in a regenerative furnace of the kind shown in our illustration, the furnace doors are lifted, and the mass is carried out and placed on the working anvil of the 14,000-ton hydraulic press. This press is truly of massive proportions, and rivals in size the great 125-ton steam hammer which it has replaced. It requires for its operation a pumping engine which is not only the largest of its kind in the world, but in addition enjoys the distinction of being the most powerful land engine in existence. It has three cylinders, working under a steam pressure of 130 pounds to the square inch, developing a maximum of 15,000 horse power. The total height of the press, above ground, is somewhat over 42 feet. The stroke of the press is recorded upon a circular dial, which is within sight of the operator who controls the forging levers. Other operators, who control the overhead cranes and other manipulating mechanism, are stationed within sight of the forgeman. The staff of men, after years of experience, have become so well trained that in obedience to a few simple motions the massive forging is lifted, turned over and generally manipulated with an ease which must be seen to be appreciated. The ingot, in this first forging operation, is roughed down to a rectangular cross-section similar to that of the finished armor plate, but considerably thicker. It is then prepared for cementation.

To accomplish the cementation, the forging is placed in a carbonizing furnace in such a manner that the gas flames can play entirely around it, the face to be hardened being brought in contact with a layer of carbonaceous material. These furnaces are fired by the regenerative principle, as explained in our first article on the open-hearth process. The heat of the furnace is gradually raised until the proper temperature is attained. This temperature varies with the size of the plate, and is determined only by experience. The plate is maintained at the proper temperature for a period of from three to four weeks, during which time the carbon is absorbed by the face of the plate to a depth of from 1 to 1½ inches. After the absorption of the proper amount of carbon, the plate is taken out of the furnace, cleaned and scaled, the loss due to oxidation being considerable.

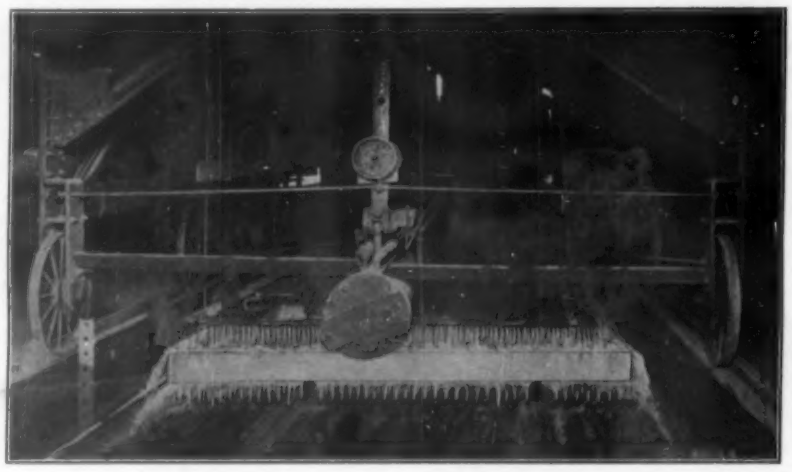
Later it is returned to the forge, brought to a bright heat, and reduced under the hydraulic press to the desired thickness.

The plate is then sent to the machine shop, where test specimens, which represent the physical qualities of the plate, are removed and subjected to tensile tests in the presence of navy inspectors.

Notable among the many operations to which the plate is subjected is the proper forming or shaping of the plate. This is accomplished by means of a 7,000-ton bending-press, where skilled artisans, after exercising a vast amount of patience, finally succeed in reducing it to the desired form.

Again and again this mass, which, it must be remembered, weighs as much as a locomotive, is placed on cars and transported from one building to another, to be subjected to operation after operation, until at last it is prepared for the final hardening operation.

When this stage is reached, it is transferred to a room where it is placed on a trolley and run into the hardening furnace. When it has reached the proper temperature, it is removed from the furnace and hardened by spraying with water. The amount of water that is necessary per hour to properly harden one of the large plates is more than is consumed per day by a city of 30,000 inhabitants.



The plate is heated in a furnace and then sprayed on both sides with water under pressure.

Hardening the Plate.

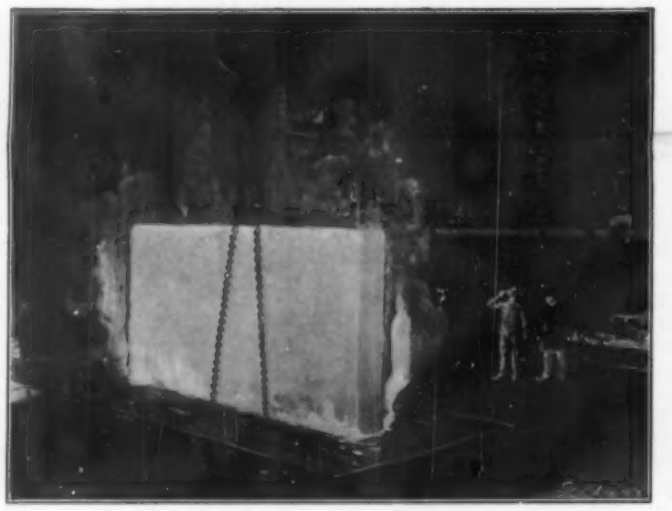


Plate is heated and lowered bodily into a bath of oil.

Oil Tempering.

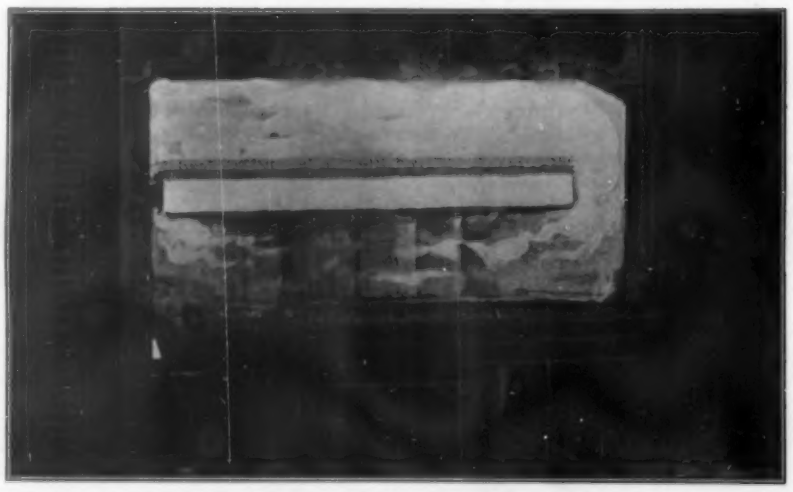


Plate is placed face upward in furnace, covered with a layer of carbonaceous material, and maintained at a predetermined temperature for from 20 to 30 days.

The Cementation Furnace.

After the plate has been oil-tempered it is again carried to the bending press, where it is heated by a special process, and "rectified" to the proper shape.

The plate then resumes its travels, journeying to the machine shop, where additional tests are taken for the information of the navy inspectors, and where it is subjected to its finish machining by means of grinding machines. We have seen that in a previous operation the plate was rough-machined. In accomplishing this the various tools, however, only work down to a point at which the carbonized face commences, this face being so hard that the finishing cuts can only be laboriously taken off by means of grinders, the hardest steel tools which can be produced refusing to cut it. All warped surfaces, such as those at the port holes and the sighting holes, have to be chipped and finished by hand with files, etc., the outer hard portion being ground.

The holes for the bolts by which the armor is fastened to the backing and framework of the ship are now drilled. These holes are drilled, of course, by machinery, several distinct operations being required for each one. The accuracy required is such that the final tapping of the thread is subsequently done by hand.

Tapping the bolt holes being the final machining operation, the armor plates are collected for what is known as assembling or erecting, which consists in joining the plates, just as they are intended to be erected on the ship. Two of our illustrations show this work being done, one of them representing the side armor of the Russian battleship "Retvizan," and the other the forward turret of the battleship "Alabama." The joints are finished with electrically driven emery grinders, and in spite of the great weight and size of the plates, the fitting of these joints is remarkably close and accurate.

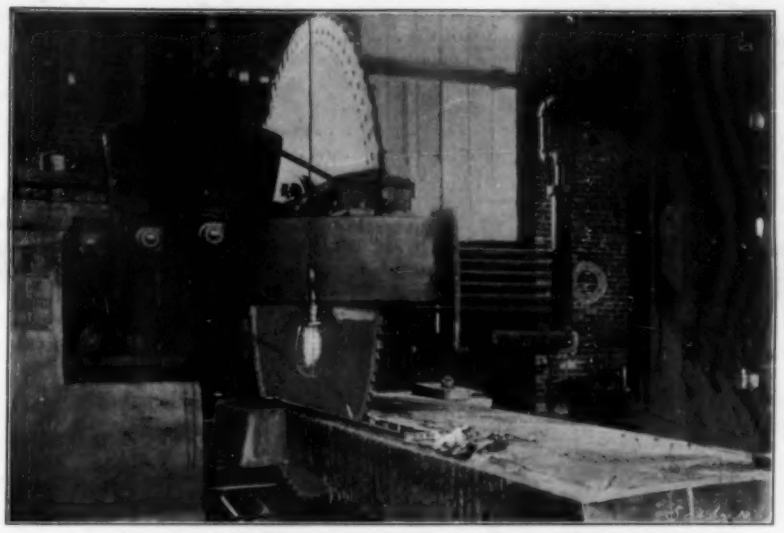
As soon as the armor is assembled and the bolts tried in the holes, it is inspected in all its details by a corps of United States navy inspectors, after which the armor is taken down, the armor bolt holes are filled with a mixture of tallow and white lead, and the plates are stamped under the supervision of the navy inspectors with the name of the ship and the particular location in which the plates are to be placed.

The final operation consists in taking the plates to the weighing machine, where the inspectors make a careful record of the weight of each plate.

In tracing the course of an armor plate through this elaborate process from the time it is cast as an ingot to the time that it is weighed and shipped from the works, the reader must have noticed how frequently the material is transferred from shop to shop for the different processes necessary to produce a modern, high-class plate. The buildings required for the various steps in the manufacture are such in dimensions that every round trip of the plate from the bending press to the machine shop, for instance, involves a journey of 4,000 feet. Another mile is covered in the transfer from the forging press to the machine shop, or from the tempering plant to the machine shop, and two miles are covered in the journey from the open-hearth furnaces to the forging press. It is further to be borne in mind that, while an ingot at the commencement of its journey will weigh 125 tons, the weight of the finished product, upon which the payment for the plate is based, will be only 30 tons, or say 24 per cent of the ingot weight. A further element of expense is the large percentage of losses which are liable to occur, owing to the risks of failure in the various processes. The plant, moreover, is of an exceedingly costly nature. An important element of cost is due to the fact that improved methods of armor-plate manufacture are liable at all times to be devised, with the result that the existing plant may become obsolete long before it has turned out sufficient armor to cover the cost of installation. Krupp armor, for instance, has shown such vast superiority over Harveyized armor, that the latter has become practically obsolete, and is only being manufactured in this country as the result of the prejudice

displayed by Congress in its refusal to pay the necessary price for Krupp armor.

The greater cost of Krupp armor is due to many causes. The composition contains expensive alloys which are not found in Harveyized steel; it is much more sensitive to error in treatment, and the percentage of loss is considerably greater. While there are about a score of general operations in the Harveyized process, there are something like double that number of separate steps in the Krupp process, and in a case where one heat would be sufficient for the forging of Harveyized plate, four or more separate heats would be required to do the same work on a Krupp ingot. Conclusive evidence of the superiority of the Krupp to the Harveyized steel is given in the fact that while Harveyized side armor for the American battleship "Illinois" weighs 700 tons, the same protection will be afforded to the sides of the Russian battleship "Retvizan," now building at the Cramps, by only 548 tons of Krupp steel. The difference between these two represents the disadvantage under which the United States battleships are being placed by the unreasonable opposition of Congress in a matter upon which it has never taken the trouble to obtain proper technical information.



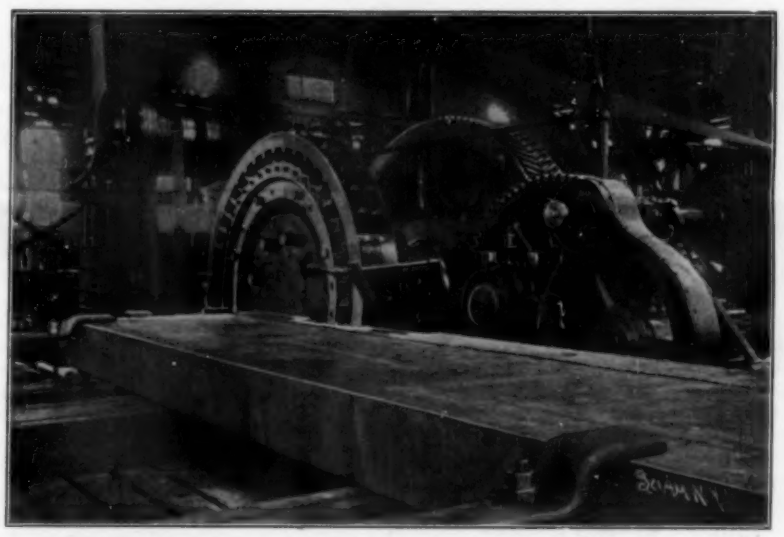
Body of saw, 84 inches diameter. Will saw through plate 24 inches thick and 33 feet long.

Rotary Saw.

Holland's Fight with the Waters.

One of the best books on Holland, which has appeared in a number of years is Mr. David S. Meldrum's "Holland and the Hollanders" and we take pleasure in giving some facts taken from this book which are not generally known. The history of Holland is the history of a continual fight against the waters and a chronicle of a reclamation of land from the sea. It is little wonder that in Holland hydraulic engineering is a profession of the first order. A very small portion of Holland lies above the level of the sea, and the rivers that flows into it. The provinces of Brabant, Limburg, a section of Utrecht, Gelderland, Overijssel and Drenthe and a part of Groningen are alone above the level of the sea or rivers. This may give some idea of the enormous amount of work which had to be accomplished to make Holland habitable, and the precautions to keep it so are never-ending. Since the Middle Ages the Dutch have been reclaiming sections of the country. The greatest work of this kind was the draining of the Harrlemmer Meer; the result is that 41,675 acres, in all, were reclaimed.

A canal was dug encircling the Haarlem Lake and a dike was built on the inner side, then engines were planted at different points on the dike and in four years the lake was dry. Eight hundred million tons of water were pumped out of the lake. The pumping engines were built in England and were enormous affairs, although they could only develop 500 horse power each. The first engine built worked eleven pumps, 63 inches in diameter, and the stroke was 10 feet. The two other engines were even larger. After the water was pumped out canals were dug and the whole area was further divided into sections by small canals, and in two years the fields were covered with colza. The total cost of the work was about $4,000,000. Of course, pumping engines still have to be employed to take away the excess of rainfall, and the water which infiltrates. Naturally after the Haarlem Lake was drained with such good success the Dutch people turned longing eyes toward the Zuyder Zee and many schemes were proposed with this end in view. There seems to be no immediate prospects of any of them being carried out. The island of Wieringen supplies the natural starting point for the works. From mainland to mainland the distance is about 35 miles and an embankment, 216 feet wide, would have to be built. This would carry a railroad and also provide for traffic. It is thought that this embankment could be built in ten years. Access to the canals would be obtained by lakes between Wieringen and North Holland. If the work should be begun now 800,000 square miles might be under the plow by the middle of the twentieth century and the estimated cost would be $150,000,000. Of course, if this were done like all polders, it would be necessary to keep them dry from hour to hour and day to day for ever afterward. A "polder" is any basin made dry, and the greatest polder of all is the "lowlands" of Holland, for right below the level of the outer water there was a swamp, if not the sea; just as the smaller polder was drained, it has to be kept drained, so the whole of the lowlands reclaimed from the waters are kept only by continual and strenuous labor, and it is a perfectly true saying in Holland that its safety may be questioned merely by half an inch of water.



Will take 6-inch cut from edge of 10-inch plate faster than saw will cut off a 6-inch strip from same plate.

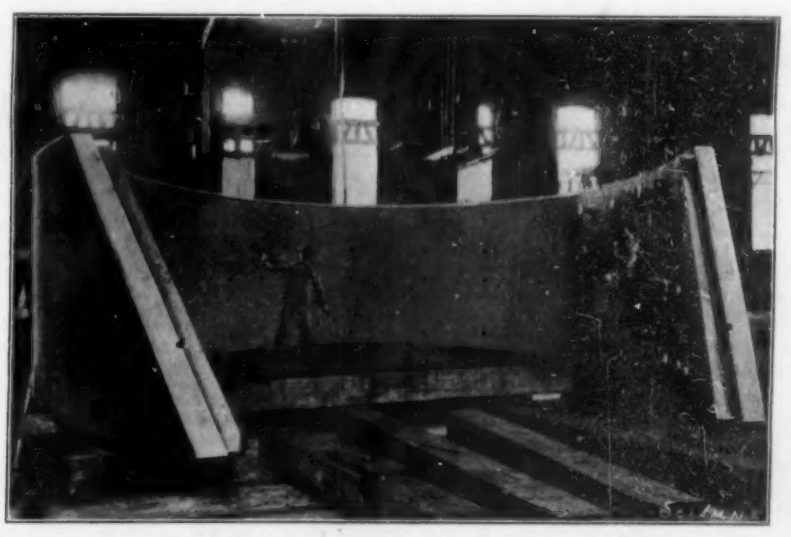
Rotary Planer.

A system of impoldering from the sea by the conjoint action of nature and of man is being accomplished in various parts of the country. The ocean leaves against the dike faces, rapidly at first, more slowly as the deposits mount higher, layer upon layer of clay, and at last keeps a dry head above the waters save at high tide. Once lifted above the sea level the embryo dike becomes covered with a growth, and while agriculture is not possible, for the high tide still overruns them, sheep and cattle are allowed to graze upon them and at length when the soil has mounted sufficiently high to seem to justify impoldering, they are encircled by dikes, and the work of reclamation goes on. Farmers assist the work of nature by digging ditches which catch the mud and thus begin the operation. When a dike is threatened by a flood it is protected by osiers placed upon its face, and if the waters appear likely to mount over the dike then the dike slopes are temporarily heightened by planks and the polder proprietors have to supply laborers as in feudal days the proprietors supplied soldiers. Property of all kinds may be appropriated, and where very heroic measures are required even houses have been destroyed. Naturally every care is taken to regulate the rivers as far as possible. The canals of Holland are its salient feature, and they assist not only commerce, but also the schemes of drainage. The North Holland Canal which cost over $6,000,000, is the most famous, but Ymuiden Canal is, while not picturesque, the one principally used. It is called the North Sea Canal. The new lock at Ymuiden is 735 feet in length, 82 feet wide, 33 feet deep.

The whole story of the fascinating fight of the waters forces upon us the consideration that, however, brilliant and daring and successful it has been, if it had not an enduring and ennobling influence upon the national character, then it would have been in vain. No estimate of Holland and the Hollanders is complete that omits the consideration of the picture of the whole nation going about their daily work peacefully, below the level of the sea, secure in the constructive skill and patience and daring which have bridled its powers and opposes a barrier to its assaults.

THE following formula is given for obtaining phosphorescent prints upon paper: Water, 500 cubic centimeters; white gelatine, 125 grammes; glycerine, 1 gramme. The solution is made over a water bath, and while the mixture is well stirred, 350 grammes of phosphorescent sulphide of calcium, mixed with a little sub-nitrate of bismuth, is added. The paper is coated with two layers of the mixture, and afterward a layer of copal varnish or shellac may be given if it is to be much exposed. This process is said to succeed very well either with negatives or superposed objects.

Assembling the Side Armor (Krupp) of the Russian Battleship "Retvizan."



The port plate (see first-page engraving) will be laid on the inclined edges.

Turret Armor (Harveyized) of the United States Battleship "Alabama."

MANUFACTURE OF ARMOR PLATE AT THE BETHLEHEM STEEL WORKS.

Automobile News.

A trip from Berlin to Paris has been made by Herr Arthur Reuter, who started from Berlin on the 27th of May, and reached Paris on the 5th of June. The route followed included the cities of Madgeburg, Brunswick, Hanover and Cologne; Aix-la-Chapelle and Liegé; Namur, Givet and Rheims, making a total distance of 715 miles. Herr Reuter stayed two days at Aix-la-Chapelle, and at Liegé; he covered the distance from Liege to Paris in 21 hours.

At the last general meeting of the Automobile Club of France a number of questions were warmly discussed. The opposition party contended that the club should do more for the encouragement of the automobile industry, seeing that it has a large revenue at its disposal, and the other party maintained that it was to meet the expenses connected with the establishment; this and and other questions led to a stormy discussion. After the general meeting, a number of prominent members handed in their resignations as committee men, and decided to found a new club, this to receive the name of Moto Club of France.

An important agreement has been concluded between the seven principal French railway companies and the Belt Railway of Paris, by which the conditions have been fixed for accepting vehicles of all kinds as ordinary baggage. The text of the agreement is as follows: The following will be accepted as baggage under the usual conditions established for baggage of all kinds, especially that their dimensions are such that they may be easily put into the baggage car, namely, motocycles, automobile tricycles and automobile carriages; when unpacked their weight is not to exceed 330 pounds; when packed in boxes, the weight is limited to 220 pounds.

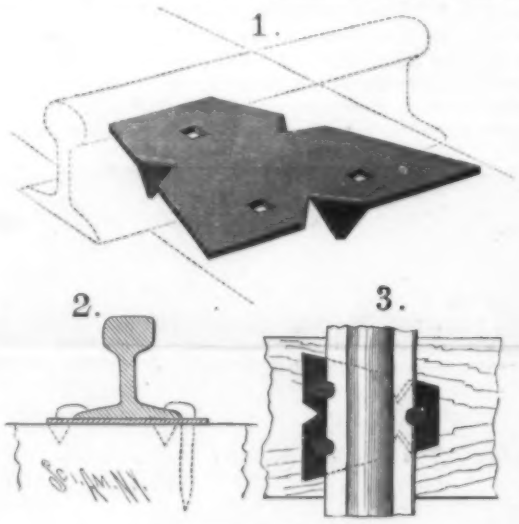
A number of experiments will soon be made by the German army with different types of automobiles for military service; the railway brigade has charge of the matter and are to make a series of trials in the open country, in the neighborhood of Eberswalde, a small town about 25 miles from Berlin; the trials will be made under the supervision of the lieuteuant-general, nine officers of the general staff, eleven captains, two officers of the engineering corps, a number of subordinate officers, artificers and privates. In France a series of grand maneuvers will take place this year in the eastern part of the country, in which a number of different types of automobile will be tried, such as petroleum and electric vehicles, motocycles, besides a number of heavy Scotte traction engines for the transportation of freight and baggage. The experiments are to be carried out on a large scale, and the organization has been entrusted to Mr. Journu, who has been for some time past engaged in the special study of applying the automobile to military purposes.

An interesting automobile fête has been held recently at Vincennes Park, which closed the contest of touring vehicles; it was the first official fête organized at Vincennes by the Exposition Administration, and served in some measure to inaugurate this annex to the Exposition, which is to contain many of the automobile exhibits. The race track around the lake was filled with various types of automobiles, their number being estimated at 300, representing a total value of 3,000,000 francs. The fête consisted of different displays of skill by the conductors, evolutions of automobiles, and tests of the brakes, and a procession of all the vehicles, many of which were decorated with flowers. In the tribune were many persons prominent in automobile affairs, among whom were the Baron de Zuyler, President of the Automobile Club; Messrs. Jeantaud, Forrestier, Krieger, E. M. Mix, Postel-Vinay and others. Most of the machines were of the petroleum type, a notable exception being a heavy covered freight wagon, made by the Postel-Vinay Company, which also constructs the Thomson-Houston material for France. It was conducted by Mr. E. M. Mix, chief engineer of the company. The motors are of peculiar design, and are placed in the extreme rear; the accumulator box is placed between the front and rear axles. The touring races, which were held previous to the fête, were not satisfactory, owing to the restrictions as to speed, etc., made by the authorities, and it has been decided that a fresh competition will take place within a month.

Among the electric automobiles especially remarked at the eighth annual exposition which has been recently held at Brussels, is the four-seated phæton constructed by the Lefert Company of Ghent. It is capable of making a run of 43 miles at a speed of 19 miles per hour. The body of the vehicle is constructed of polished Canada birch, giving it a pleasing appearance. It is provided with a motor of the Lundell type, of 3½ horse power, which is supplied by a set of forty-two Tudor batteries. The weight of the vehicle is 1,200 kilogrammes and that of the accumulators, 600. The capacity of the batteries is 130 ampere hours at a rate of discharge of 13 amperes, at a discharge of 22 amperes, 110 ampere hours are given. A large electric gong, whose contact is operated by a pedal, gives a loud signal and replaces to advantage the trumpet with rubber bulb generally used in Europe. Two pedal brakes are provided, one of which, the weaker, acts directly upon the differential, the other being a strong brake of the band type. The different speeds are obtained by the displacement of a lever whose operation is very simple and the four points are used for the starting or for the speeds of 9, 18 or 25 miles per hour. Another type of electric automobile, shown at the exposition, is a hotel omnibus of eight places, built by the Société l'Electrique. Its rear axle is provided with two Westinghouse motors of 4 horse power. The accumulators used are of the Julien make of an improved pattern; of these 40 cells are used. The total weight of the omnibus is 4,180 pounds, and the accumulators weigh 1,540 pounds. The capacity of the batteries is 150 ampere hours; a speed of 9 miles per hour may be reached, which permits the omnibus to cover a distance of 25 miles without recharging.

A COMPENSATION TIE-PLATE.

To prevent the uneven settling of rails in softwood or partly-decayed railroad ties and reduce the consequent tilting of rails or spreading of track in curvature a tie-plate has been designed and patented by Mr. Henry Herden, Chief Engineer of the Buffalo and Susquehanna Railroad, Galeton, Penn., in which the two ends of the plate when in position under the rail, present different areas of contact with the tie at the inner and outer edges of the rail base. These contact areas conform more proportionally to the different loads to which the ties at the base of the rail are subjected, the greater loads taking effect at the outside of the rail. The plate having greater area at the outside of the rail will offer more resistance to penetration into the wood than the opposite end, causing the plate to settle more uniformly, whereby, it is claimed, that the rails are assisted in maintaining their position at right angles to



A NEW TIE PLATE.

the surface of the tie when soft wood is used or material which has become defective from age or service, and that tilting of the rail and spreading of track is prevented. The life of the ties as well as of the rails and wheels is therefore prolonged. The economical distribution of material in this plate reduces its weight, there being no surplus material used next to the inside of the rail, as our illustrations show. The plate is provided with three triangular lugs, cut out and bent at right angles to the plate and designed to penetrate the fibers of the wood in a diagonal direction.

The Operations of the Kiel Canal.

The administration of the Kiel Canal, Germany, has lately published a report for the year included between April 1, 1898, and March 31, 1899. The number of vessels which have passed through the canal during that period reached 25,816, of which 11,005 represent steam vessels and 14,811 sailing vessels, etc. The total tonnage is estimated at 3,117,840. These figures show an increase over the preceding year of 2,708 vessels and 648,000 tons. The receipts of the canal during the year amount to about $400,000, which is an increase of $80,000, or 20 per cent. As to the different nations using the canal, Germany naturally takes the lead with 87 per cent of the total number of vessels, and 68 per cent of the tonnage; England has about 9 per cent, which is an increase over the preceding year. Denmark and Sweden have respectively 6·9 and 5·7 per cent, showing a slight diminution. Russia, whose proportion was 2·54 per cent in 1897-98, has now 2·29. From a financial point of view, the situation is considerably better than for the preceding period, the deficit being but $108,000 against $245,000. The receipts have increased about 26 per cent and the expenses diminished 9 per cent. The report brings out the fact that as the Kiel Canal has been constructed mainly from a strategic point of view, it is not to be expected that it will give any considerable profit; nevertheless, the constant increase in the revenue leads one to expect that the receipts may in time come to equal and even exceed the expense of maintenance.

Electrical Notes.

Electric lights are being installed experimentally in the Imperial Court, at Tokio, Japan.

A New York company is to establish a factory in Milan for the purpose of the manufacture of electric traction material.

It has been found by experiment that a thick coating of nickel can be obtained by using the ordinary plating solution and passing both alternating and direct currents through the bath.

A wireless telegraph service has been opened between the German island of Borkum and the Borkum Reef Lightship, in the North Sea. Ships are reported by this means between the hours of 6 A. M. and 8 P. M.

A Viennese dentist while experimenting at the Hygienic Institute at Wurzburg, claims to have discovered the successful application of electricity for the destruction of bacteria. It is said that the treatment is very simple.

The overhead trolley system not only damages underground pipes, but it also injures trees. Wherever a cable touches a branch it rapidly decays and the tree eventually dies. Serious complaints of this nature are made at Bay Ridge, N. Y.

The South Chicago Street Railway Company has introduced whiskbrooms and clothes brushes on its cars. They are kept in a small cabinet in the forward end of the car, and passengers are invited to use these articles on the rear platform.

The technical school for the textile industry at Aix-la-Chapelle has recently been fitted with machinery for dyeing, bleaching and printing fabrics. The machinery is on a considerable scale. Electrical bleaching is also done, platinum-iridium electrodes being used. Great attention is paid to the strengthening of the fibers before and after testing.

The principal switch towers and cabins on the London and Northwestern Railway are to be provided with electrical motive power for working the switches and signals. At present it requires some time and considerable exertion to pull the weight of a long length of rod or chain. The new system will enable the switches to be worked much more rapidly.

All vessels passing through the Suez Canal must satisfy the agents of the Canal Company that they have on board one electric searchlight of a power sufficient to illuminate the channel for a distance of 4,000 feet ahead, and constructed so as to admit of rapid splitting up of the beam into separate segments with a dark sector in the middle, and also, says The Electrician, with electric lights capable of lighting up a circular area 700 feet in diameter.

A miniature electric railway is in course of construction in a small private park at Macon, Mo. The railway is a mile in length and the gage is 3 feet 2 inches. Each car will accommodate eight passengers, and the train will be lighted by incandescent lamps. Current will be supplied from a nearby academy power plant. The railway is being built for the benefit of children of wealthy families, one of which owns the park through which the line runs.

In the yards of the Atchison, Topeka and Santa Fé Railway, at Fort Madison, Iowa, electricity is used to light the signals. The ordinary switch lamp is used with an 8-candle power incandescent lamp inside fitted to a socket. The current is brought to the signal post or switch stand in underground conduits, and is arranged so as to enter the lamp at the top. The experiment is said to be highly satisfactory, and it does away with lamp tenders. The electric lights are very safe from extinguishment by wind or the jar of a passing train.

A brief digest of an article relating to electroscopes appears in the Elektrotechnische Zeitschrift, the author describing a vacuum electroscope which he had had constructed for experimental purposes. The apparatus has the form of a pear about 12 cm. in length, its top consisting of a hollow aluminium ball which rests upon an aluminium wire welded into the glass. The wire projects into the interior of the electroscope, where it takes the form of a flat ribbon, to which the broad pendulum leaves are attached, these latter being of aluminium foil about 1 cm. long and 1½ mm. broad. In the lower portion of the glass bulb are two platinum wires welded into the sides of the bulb, the distance between them amounting to about 0·4 mm. Experiments with the instrument proved the vacuum to be a perfect insulator, and that intensive electrostatic effects might be obtained in the same. The ordinary electroscope experiments succeeded when applied to the apparatus, though the heavy charges on the glass walls which occurred during these experiments had a disturbing influence. When the apparatus was observed in a dark room, no trace of luminosity was apparent in it during the occurrence of strong electrostatic effects. Discharges of electricity into a vacuum are therefore dark, from which it may be concluded that the phenomena of light are dependent upon the presence of ponderable material.

A CALIFORNIA CYCLEWAY.

BY CHARLES FREDERICK HOLDER.

Among the many new constructions that are to be seen in Southern California none are of more practical interest than the Pasadena cycleway, now nearing completion and already opened to the public for bicycles and motorcycles. Southern California has especial attractions to the wheelman, as the season is the whole year. The winter, which is virtually lost in the East, is open here, and really the most delightful time, when the country has taken on a coat of green and is radiant with wild flowers. This fact and the assurance of good roads all over the State brings out numbers of wheelmen, and a conservative estimate places the wheels in Los Angeles and Pasadena, resident and visiting, at thirty thousand, and the inventors of wheels at five thousand.

The Pasadena and Los Angeles cycleway is a movement to provide the wheelman with a perfect road, with a minimum grade between two cities nine miles apart and at different altitudes. The inventor and promotor of the novel scheme is a wealthy resident and trustee of the city of Pasadena, Mr. Horace Dobbins, he being the president of the company, the vice-president is ex-Governor H. H. Markham. The cycleway, which it is believed is the only one of its kind in the world, is an elevated perfectly adjusted road running from the heart of Pasadena to the plaza of Los Angeles. In appearance it somewhat resembles the elevated road in New York, being apparently as high in places; but it is built of wood instead of iron, yet strong enough to bear the equipment and car service of an electric road. The accompanying photograph shows the section leading from the depot in Pasadena proper to the site of the former Raymond Hotel. Here it makes a turn and continues on to South Pasadena, then through a beautiful country flanked by green hills, with everywhere a view of the range of the Sierras that are often covered with snow. In fact, one object of the cycleway is to give a scenic route through one of the charming localities of Southern California.

The portion shown is but one-half of the road; in brief, when the cycleway is complete, it will be twice as wide, which warrants the assumption that the promotors may have some additional object in view—something else than to afford wheelmen and wheelwomen a perfect road. Whether this is true has not been given out, but a few days ago an automobile owned by a resident of Pasadena, was run out upon the cycleway and went speeding toward Los Angeles under the most perfect conditions; and it was evident that if the road permitted an automobile to run upon it, it would soon become very popular—a literal sky route to Los Angeles for these vehicles.

A critical examination of the cycleway is interesting, showing it to be a somewhat remarkable piece of engineering. The proposition has been to give wheelmen a grade from Los Angeles to Pasadena up hill and a decided rise at that which will not be appreciable, and this has been accomplished. The roadway ranges from 3 to 50 feet in height, giving a maximum grade of but three per cent; and this but for two thousand feet; at all other points it will not be greater than 1¼ per cent. This is about the grade of Broadway in Los Angeles in the heart of the city, and not appreciable to the average wheelman. The cycleway, with its heavy wire sides painted dark green, is not an objectionable feature, as it winds away through the hills like a gigantic snake. It is at present wide enough to hold four wheels abreast, and has the right of way for a duplication in width. The timber used in the construction is Oregon pine; 1,250,000 feet were required to complete it, and twenty miles of heavy wire netting.

At intervals of 200 feet over the center, incandescent lights are being placed, which at night will convert the cycleway into a gleaming serpent. The terminal stations are Moorish in design; one being placed near the Hotel Green in the business center of Pasadena, and the other at the plaza in Los Angeles. At these buildings, which will be equipped with the facilities of a railway depot, will be a department for renting bicycles and motorcycles; also a repair shop. So one may rent a wheel at Pasadena, and run down to Los Angeles and leave it there if desired, or vice versa; or a motorcycle can be taken at either city, leaving the cycleway and carrying the passenger to any part of the city.

The route of the road was selected by the inventor with great care, and as a result of several years' work in securing rights of way and legislative action. The track runs through Pasadena, South Pasadena, Highland Park, down the picturesque Arroyo Seco, following the Los Angeles hills into the city. These hills form a picturesque feature of the region; they are very abrupt, and surround an attractive little valley, and are in reality the broken up foothills of the Sierra Madre Range. Here the cycleway will have its casino that will doubtless prove an attractive feature. The crown of one of the most beautiful of these hills has been selected from which a magnificent view of the surrounding country is to be had. Merlemount, as the casino is called, stands in the center of a part of one hundred acres, reached from the cycleway by walks, wheel or motorcycle. This is being laid out into walks and various conveniences for wheelmen. The casino itself will be delightful in its beauty of situation and equipment. The building will be 200 feet in length, surrounded by a broad piazza and protected by a wealth of tropical and semi-tropical plants. At one end will be a circular rack for ladies' wheels and a ladies' waiting room fitted up in the Turkish fashion. Besides these there will be reception rooms, café and restaurant, while part of the basement is to be a Swiss dairy complete in all its furnishings.

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BIRD'S-EYE VIEW OF THE CYCLEWAY.

"GLENARM CURVE" ON THE CYCLEWAY BETWEEN PASADENA AND LOS ANGELES, CALIFORNIA.

From this hill one of the most comprehensive views in Southern California is obtained. The Sierra Madres—a wall 6,000 feet in height—overshadow the San Gabriel Valley, not 10 miles distant. To the east rise the peaks of Mt. San Antonio, Mt. San Jacinto and Mt. San Bernardino (sentinels of the land of the orange and olive), rising 9,000 and 11,000 feet in the air on the edge of the great California Desert. To the south and west, the blue waters in the Pacific glisten in the sun, and twenty miles out to sea can be seen the island of Santa Catalina. The intervening country is the garden spot of the State, with acres of lime, lemon, orange, and olive trees and almost all the important fruits of the world.

The cost of this cycleway is insignificant when everything is considered, being but $187,500. The toll is ten cents by book tickets between Pasadena and Los Angeles (eighteen miles), the park and other features being free. This toll permits a bicycle or motorcycle to enter the cycleway, and ride up and down all day, if desired. It has been estimated that if half of the wheelmen in the two cities patronize the road once a month it will give the cycleway an income of $20,000 per year, which would seem a very conservative estimate as the roads on Sunday between Los Angeles and Pasadena are often filled with wheelmen, who ride through the dust, taking the heavy grade between the cities without question; and that the majority of them would choose the perfectly smooth road is without doubt. It is to be hoped that the cycleway will be the financial success, as it promises to be a boon to thousands of devotees of the wheel in Southern California, and, doubtless, will be the initative for such roadways all over the country—certainly in the vicinity of the large cities.

The Castle of Ulysses.

In Ithaca there are ruins which are generally known as the Castle of Ulysses. Although cyclopean walls with gate openings are found, and the site, which is 400 feet above the sea, was adapted for the residence of a pirate chief, many archæologists have been doubtful whether the identification of the place should continue to be accepted. Dr. Dörpfeld has been provided with funds to undertake a more thorough exploration of the ruins than has hitherto been attempted. Several years ago he examined the island of Ithaca and fixed on a site in another part of it. He has since come to the conclusion that the residence of Ulysses is not to be found there, but in the island of Leucadia or Santa Mora and near the town of Leucas, which some have identified as the Homeric Nericus. Leucadia, it will be remembered, has poetic associations, for from one of the cliffs Sapho committed suicide. She was passionately in love with a beautiful youth named Phaon, and as she failed to obtain a return of affection, she is said to have thrown herself from the promontory under the belief that those who took that leap would be cured of their love, if not destroyed. In some ways Leucadia corresponds more closely with the description in the Odyssey than does Ithaca, but it will undoubtedly be difficult to persuade scholars to abandon such an ancient tradition.

The July Building Edition.

The July issue of the SCIENTIFIC AMERICAN BUILDING EDITION is the 117th number of this periodical. It contains many interesting features such as "A Tile Front of a Russian Sanctuary at the Paris Exposition," "Staircase Hall of the Breakers, Newport, R. I., "The Heart Country Seat at Pleasonton, Cal." There is also a page of "Stair and Arch Details." A number of houses of various prices are illustrated. All of our readers may not know that pictures of houses are only published after the house has been actually built, wash drawings or elevations not being used.

The Current Supplement.

The current SUPPLEMENT, number 1280, has many valuable articles. The front page is given up to an article on "Frost Fighting," by Alex. McAdie and shows how the orange and lemon crops are protected in California. It is fully illustrated. "The Art and Craft of Garden-Making" is a review of a new book. "The Means of Defense of Animals," Part IV., deals with protection against living animals. The Palace of Electricity at the Paris Exposition is illustrated. "Cotton Supplies" is by John A. Banister.

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RECENTLY PATENTED INVENTIONS.

Agricultural Implements.

BEAN-CLEANER.—CHARLES W., JAMES J., and WION P. THOMAS, Sawyer, N. Y. The purpose of the invention is to provide a means for screening and cleaning beans. For this purpose a screening-mill combined with a brush is employed, by which brush the beans are polished and discharged from the machine. To the brush a feed-pipe is attached, projecting up through the top of the casing into proximity with a spout extending from the screening device. The feed-pipe is of greater diameter than the spout, to insure the feeding of the material from the shaking spout to the feed-pipe.

CANE-FEEDING DEVICE.—JOSÉ ELIGIO TALLET, Matanzas, Cuba. The device comprises an elevated track or frame on which a car is mounted, the bottom of which is composed of cross-bars upwardly-extending, dividing members carried by the cross-bars. Cane-receiving bars are flxedly supported by one end and extend transversely over the cross-bars when the car is at one end of its travel. The cane is dumped upon the car, while the car is beneath the cane-bars. The car being then slowly moved outward, the cane is gradually and regularly dumped upon an endless conveyer in regular quantities to the crushing machinery.

CORN-PLANTER.—MARCUS R. YATES, FRANK P. LIGHT, and ELLIOTT HEINEBAUGH, Pendleton, Ore. The invention is an attachment to a sulky corn-planter, for check-sowing or dropping the corn directly opposite each hill in the adjoining rows. The planter can be operated without the aid of a check wire or rope to drop the seed perfectly and at the same time mark so that the operator, without leaving his position on the seat of the planter, can readily determine if the machine is operating correctly.

Mechanical Devices.

DEEP-WELL PUMP.—SIDNEY M. and JOHN POLSON, Laclede, Mo. The object of the inventors has been to construct a pump which could pass within a comparatively-small casing, though of large capacity. With this object in view, two pistons are used, placed in tandem and arranged so that one operates while the pump-rod is moving in one direction and the other while the pump-rod is moving in the other direction.

JACK.—CHARLES W. DOANE, West Lake, La. The jack is especially designed for handling timbers in bridge-work. It can be clamped to the side of the timber, whether round or square, and used for lifting another timber alongside; or it can be supported on any convenient base and clamped to a timber in order to lift that timber. The jack can be used in a vertical, horizontal or inclined position.

DEFIBRATING-MACHINE.—MANUEL A. TORRE, Merida, Yucatan, Mexico. The machine is designed to clean vegetable fibers and particularly to scutch leaves. It is exceedingly simple in construction, inasmuch as a single conveying-wheel is employed. The leaf is thoroughly scutched, for the reason that it is alternately seized at its opposite ends, the raising action of a central chain (constituting one of three endless, flexible connections engaging the conveying-wheel) insuring the engagement of a lowermost chain with the proper end portion of the leaf.

HOIST.—EPHÉGE B. ACHÉ, Labadieville, La. This invention provides a dumping-hoist designed particularly for use on sugar plantations to carry the cane from the farm-wagons to the tramcar in which the cane is conveyed to the mills. The apparatus considerably facilitates the work by the employment of two dumping-carriers of special construction, which can be worked alternately, so that when one is dumping, the other is loading.

WEIGHING-MACHINE.—EDWARD W. COLLINS, Coalville, Iowa. The purpose of this invention is to provide means for controlling the feed of granular material to a weighing machine—a purpose which is attained by a novel valve mechanism, comprising a main and an auxiliary valve hung on and actuated by the scale-beam. The auxiliary valve serves to cut off the major portion of the material to be weighed; and the main valve serves subsequently to cut off completely the supply of the material. By this arrangement of main and auxiliary valves, a simple device is provided for regulating the supply to the scale-beam.

FRUIT-PARING MACHINE.—HAVEN M. HAFF, Ludington, Mich. On the framework of the machine a paring-disk is mounted and a fruit-holder is pivoted. A pulley and band connect the fruit-holder with a driving-shaft, whereby when the frame is moved backward and forward, the fruit being pared is respectively removed from or pressed against the paring-disk, thus enabling the operator to regulate the pressure against the paring-disk to correspond with the firmness or softness of the fruit.

REVOLVER.—CHRISTOPHER D. MCDONALD, Vance, Colo. In a former patent the inventor described and claimed a revolver in which the handle portion is provided with rigidly-attached upper and lower extensions inclosing the cylinder-space, and the barrel is vertically hinged between the forward ends of the rigid extensions and bears the revolving cylinder, which swings out when the barrel is deflected about the joint at the two forward extensions of the handle. The present invention is based on the same principle, but provides an improved means of articulation, so that the weapon can be readily broken, the shell ejected, and the chamber reloaded.

MOLDING-MACHINE.—MATTHEW F. ALLEN, Nashville, Tenn. The invention provides a device which can produce castings for "metal hollow ware" more rapidly than by present methods, and which can be moved about over the foundry floor, so that the sand can be shoveled directly from the floor into the machine and the finished molds deposited upon the floor back of the machine, thus obviating the necessity of transporting the sand to the machine and the molds from the machine to the floor. With this apparatus it is possible to mold and pour continuously.

RAG-ENGINE.—EDWARD A. JONES, Pittsfield, Mass. This engine is arranged to relieve the beating drums of unnecessary pressure of the entering pulp, thus saving power in driving the engine and insuring a thorough mixing and agitating of the pulp and a rapid circulation to avoid streaks. The inventor employs a backfall having its face adjacent to the beating-drums provided with spaced-apart sets of ribs for mixing the pulp after leaving the drum.

AUTOMATIC AIR-PUMP.—CICERO M. HOBBY, San Diego, Cal. The construction devised can be used as well for exhausting as for compressing air. The novel features of the invention are to be found in a receptacle closed to the atmosphere and having a liquid-inlet, a valved air-inlet and a valved air-outlet, a siphon connected with the receptacle, and a valved connection between the arch of the siphon and the air-outlet. The use of a closed receptacle very radically affects the usual action of the siphon.

Railway-Appliances.

AUTOMATIC CAR-AXLE LUBRICATOR.—PIERPONT T. LANGDON, Audubon, Minn. The lubricator comprises a trough in the axle-box, having two flanges extending up at the sides of the axle-journal. On one end of each flange is a hook, and on the free end of the axle-journal is a cap-plate, radially projected and provided with a circular edge. The hooks on the side flanges of the trough engage with the edge. A scraper blade is mounted on the end of each side flange below the hook. These blades come in contact with the cap-plate to scrape the lubricant therefrom into the trough.

STOCK-CAR.—HARRY C. CARSON, Virden, Ill. This invention is an improvement for changing stock-cars from single-deck to double-deck and *vice versa*. The car has vertical side studs or uprights and alined blocks, both of like thickness and width. The blocks are separated from the studs by narrow spaces which receive cross-bars. Floor-sections which have parallel cross-cleats on the under side, and side notches are adapted to receive the previously-mentioned studs and blocks, so that the section may slide up and down thereon. Supporting-posts are connected with the cross-bars and are adapted to enter sockets therein and in the floor of the car. The cleats are separated to accommodate the cross-bars between them as required when its floor is elevated, and are arranged in pairs separated to receive a bar and post between them as required when the floor is lowered.

JOURNAL-BOX AND LID.—JOHN D. MURRAY, Albany, N. Y. The journal-box has a recess in its top and a hinged lid. A plate-spring is fastened to the inner face of the lid, the upper free end of the spring being curved in to pass under the upper rim of the box opening into the recess. The spring constantly pulls the lid uniformly against the seat when the lid is closed, to render the box dust-proof.

Miscellaneous Inventions.

NOZZLE.—VICTOR C. SWANSON, Salem, S. D. The nozzle is so constructed that it can be turned to different angular positions with respect to the head of the hose, and for that reason is particularly serviceable in cleaning boilers provided with small handholes not of sufficient size to enable a workman to insert both hands in the boiler.

BUCKLE.—EMANUEL REYHING, Manhattan, New York city. This buckle has two interlocking members, each comprising a metal shell containing a wooden block in which an eye is secured projecting beyond the shell to engage a keeper. The front faces of the two members are perfectly flat and can be readily ornamented to enhance the appearance of the buckle. If desired, a simple ornament can be applied to one of the members, so as to give the buckle the appearance of being of one piece. The construction of the buckle is far stronger than that ordinarily employed.

PROCESS OF MANUFACTURING LIME AND CARBONIC ACID.—GUSTAF M. WESTMAN, Manhattan, New York city. By this process, both lime and carbon dioxid are produced for the market. In the apparatus a mixture of highly-heated carbon dioxid and steam passes into and up through a column of limestone, converting the latter into calcium oxid. The expelled carbon dioxid is then charged with water, which causes the heat of the gas to convert the water into steam, thereby reducing the temperature. A portion of the cooled gas charged with steam is then conducted into a regenerator and highly heated therein, and used in turn for expelling carbon dioxid from the lime. Finally, the calcium oxid is drawn from the base of the column.

SMOKER'S PIPE.—CHARLES E. ANGELL, Salt Lake City, Utah. A passage in the mouthpiece of this pipe is turned upward at its discharge end and opens at the side. A distributer-plate bound rigidly to the mouthpiece is located over the discharge end of the passage and deflects the smoke. By these means the fumes are evenly distributed in the smoker's mouth, not concentrating upon the point of the tongue as in the ordinary form. This construction prevents liquid charged with nicotin from entering the mouth.

WRITING-TABLET.—ELISHA D. HURLBUT, JR., Brooklyn, and DWIGHT TERRY, Manhattan, New York city. This device keeps double-sheet writing paper in convenient pad form for writing and for blotting the writing without danger of soiling the paper. It consists of a back of stiff material, a series of folded sheets of paper superimposed on the back, each half of each double sheet being free at its top, bottom, and outer edges from the other half of the same sheet, thus enabling the halves to be turned over successively. There are also provided a detachable connecting medium at the creases of the sheet, a blotter at the opposite edge of the back, and flexible connections between the near edges of the back on one hand and the cover and blotter on the other, the width of the connections being about equal to the thickness of the pad formed by the superimposed leaves.

GLOVE.—HENRY SINCLAIR DELAMERE, Ferndale, Cal. The slitted wrist portion of this glove has devices for fastening the sides of the slit together. A hand portion with short open-ended finger portions has a slit extending from the outer edge of the little finger portion along the outer edge of the hand portion to the beginning of the wrist portion. A lacing on the slitted edge connects the outer and the inner hand portions with each other along the slit, and holds a hand-dressing in place on the hand of the wearer. The wrist-fastenings serve to hold the glove in position on the hand to prevent accidental displacement of the glove and the hand-dressing. The glove can be worn by oarsmen, golfers, and others.

BUTTON-DISPLAYING DEVICE.—MEYER HARZBERG, St. Paul, Minn. Collar and cuff-buttons and similar articles which need attractive display can be quickly inserted and removed in this device, which consists of a plate, having rows of tongues, each tongue with an upper narrow neck attached to its upper end to the base, and a lower, wider body fixed at its lower end to the same. The plate is adapted to receive the base of a collar or similar button beneath the lower, wider portion of the two tongues of adjacent rows. The plate is preferably made of thin metal, although pasteboard, celluloid, or other material can be used.

NIPPLE-HOLDER.—CHRISTIAN W. MEINECKE, Jersey City, N. J. The nipple-holder is a decided improvement upon a similar device previously patented, in so far as the holder is rendered more effective than heretofore and is stronger and less liable to disarrangement. The construction is simple; the few parts required can be readily assembled.

VEHICLE-TIRE.—HENRY H. GERHARDT, Nashville, Tenn. Around the rim, a sectional tire is disposed, each section consisting of a series of disks secured to the rim, and one or more of the sections consisting of a smaller number of disks than the other and serving as a key or keys to fill the space between the ends of the longer sections. The short section or sections are independently secured to the rim. A very durable tire is produced by the use of leather strips held together by nails or a suitable binding substance.

BLOTTING-PAD.—ANTON D. GLUECK, Newark, N. J. This simple device is a small pad held on the small finger during writing, by means of an elastic band. The pad acts both as a support for the hand and as a blotter. Actual tests of the pad have proven that it is very useful in such work as posting books, when the amount of each entry is small and the writer desires to turn the page to post another entry.

WATCH-WHEEL GAGE.—ROBERT L. MARSHALL, Elizabethtown, Ky. The device accurately determines whether all points on the periphery of a balance-wheel are equidistant from the center and whether the wheel is exactly true or coincident with the plane in which it is adapted to move. The invention consists of a base on which are mounted means for holding the pivot of a balance-wheel or the like and a graduated plate with a sensitive pointer or indicator arranged to be held at different places on the base, so as to bring the bent end of the pointer in contact with the side and periphery of the wheel.

PACK-SADDLE.—EDGAR F. BLISS, Providence, Arizona Territory. This inventor has devised a simple and highly efficient pack-saddle, the parts of which can be variously arranged and assembled, so as to be adapted for carrying loose and sacked ore, cord-wood, baled hay, and other bulky material. The saddle is very durable, for the reason that no ropes are employed in its construction.

STOVE.—WELLESLEY R. HAMPDEN, Spokane, Wash. It is the purpose of the invention to provide a stove in which the combustion of the fuel will be rendered more complete than has heretofore been possible. The purpose has been attained by causing the draft from the firebox to pass circuitously through various portions of the stove, thus not only superheating the fuel, but facilitating the combustion of the inflammable gases which pass from the fire-box.

PERPETUAL CALENDAR.—EMIN G. TASSO, Rue Racine 23, Paris, France. The calendar is in the form of a cylinder or polygonal tube, which bears numbers and dates. By means of this calendar it is possible to ascertain on what day of the week any given date in past or future years fell or will fall. In form, the calendar is exceedingly compact; in operation, very effective.

PHOTOGRAPHIC VIGNETTER.—CHARLES W. CHRISTMAN, Waterville, Minn. The vignetter consists of a rigid, elongated frame, placed beneath the camera and carrying at its outer end a screen which can be adjusted in any manner to enable the operator to obtain almost any effect desired.

STAMP.—MARTIN R. DRISCOLL, Frisco, Utah. The invention provides a means for attaching the stamp, so that the hitherto troublesome necessity of dressing the end of the stem to fit a socket in the head or boss is avoided. The liability of the stem to breakage is greatly reduced. Should the stem break, the fracture will be comparatively small and may be quickly drifted out from the stamp head or boss.

APPAREL-COAT.—MARK L. KELLEY, Manhattan, New York city. The coat is of the raglan style and is effectively stiffened at the shoulders, so as to retain its shape, and yet, so as to enable it to be altered to form a coat of the ordinary pattern, should the wearer so desire.

FIREPROOF STRUCTURE.—JOHN STREIFLER, Manhattan, New York city. The purpose of the invention is to provide a fireproof construction for dumb-waiters, elevator-shafts, and partitions, utilizing metal tongues to hold the parts of the structure together, which tongues are completely concealed within the structure. The sections of the fireproof structure are so attached to one another and to the tie-plates or tongues, that an ample and sightly cement connection can be made. The abutting ends of slabs or blocks used in the construction of small dumb-waiter shafts can be quickly and perfectly tied together, especially when each face of the shaft is built up of single slabs or blocks.

LUBRICATING APPARATUS.—HANK DANGLER, Cleburne, Tex. The apparatus embodies means whereby locomotive-bearings can be lubricated, either when the locomotive is moving or when it is standing still. The apparatus acts automatically to supply the journal and spreads the lubricant over the entire surface engaged. The operation is automatic as long as oil is in the supply tank.

FLY-BRUSH FOR DOORS.—CHARLES H. and ARTHUR R. ANDERSON, Buda, Ill. This device for brushing away flies and preventing them from entering a doorway when opening or closing the door is composed of a brush-shaft mounted in the upper part of the casing between the jambs. The shaft has one end reduced and formed with a spiral groove, on which end a rope is wound. A coiled spring has one end secured to the rope and its other end to the jamb of the casing to which the door is hinged. A second rope winds in an opposite direction to the first rope on the other end of the brush-shaft and is secured to the free edge of the door.

METHOD OF CONDENSING FLUE-DUST.—RUDOLF RUETSCHI, Perth Amboy, N. J. The fumes escaping from metallurgical establishments are cooled in narrow channels under exclusion of air by an external cooling medium, to precipitate a portion of the solid matter in the fumes; then the more or less cooled fumes are mingled to equalize their temperatures. A second cooling of the fumes under the exclusion of air now follows; whereupon the fumes are compressed and mixed with air. The mixture, after having been divided and expanded, is given a whirling motion in closed receptacles at the same time cooling the mixture in order to precipitate the remaining solid matter.

DESK ATTACHMENT.—CHARLES F. NESER, Elko, Nev. The attachment comprises a plate having a top and bottom member by which it is clamped to the desk. A retaining-surface on the top member of the plate is adapted to be engaged by the arm of the writer. The attachment is designed to prevent the arm of the writer from sliding along the smooth surface of the desk, and to indicate at a glance whether the arm is in proper position.

LENS ATTACHMENT FOR LAMPS.—JOHN C. MOLLOY, Cincinnati, Ohio. To increase the illuminating power of a lamp, a lens is securely held on the chimney. When the burner is lighted, the rays of light are refracted by the lens into the room.

WRITING-TABLET.—ETHELMER E. MAGEE, Waynesville, N. C.—The ordinary school copy-books necessitate the use of the entire page for the reproduction of a single copy. The present writing-tablet enables the pupil to use the same sheet of paper for several copies and thus prevents the wasting of paper. The device also provides means for concealing the work already done by the pupil, so that only the perfect copy is reproduced and not the mistakes previously made.

HEATING-DRUM.—ROBERT L. HOLLINGSWORTH, Atlanta, Ga. The drum is applied to an ordinary heating-stove or kitchen-range and is designed for heating and baking and for warming dishes and the like. The drum comprises a shell having an inlet near the top of its front end and an outlet at the rear end. An oven extends from one side to the other of the shell. The top of the oven is below the inlet and the rear end is spaced from the rear end of the shell. A transverse partition below the bottom of the oven terminates short of the front end of the shell and has an opening in its rear portion. A damper above the outlet of the shell is adapted to close the opening in the partition. A cleaning-door gives access to the space below the partition.

Designs.

BELT.—LOUIS SANDERS, Brooklyn, New York city. The belt has a diamond-shaped central portion, upper and lower continuous cords following the contour of the body of the belt, and a cord having a skeleton diamond formation at the central portion of the body.

NOTE.—Copies of any of these patents can be furnished by MUNN & CO. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

NEW BOOKS, ETC.

A HAND BOOK OF TESTING MATERIALS FOR THE CONSTRUCTOR. Text by Prof. Adolf Martens. Translated and edited by Gus C. Henning, M.E. New York: John Wiley & Sons. 1899. 8vo. 2 vols. Pp. 622. Price $7.50.

There are two volumes, one of text and one of illustrations. The author is Director of the Royal Testing Laboratories at Berlin and at Charlottenburg. To the description of the customary methods of testing, the author has added a presentation and discussion of the most important types of testing machines and auxiliary apparatus. The editor has done well in selecting such an authoritative book for translation. It is certain to take a prominent place upon the book shelves of the engineer, for there cannot be too many books of this kind.

ANNUAL ANALYTICAL CYCLOPEDIA OF PRACTICAL MEDICINE. By Charles De M. Sajous, M.D., and one hundred Associate Editors. Vol. V. Philadelphia: F. A. Davis Company. 1900. 8vo. Pp. 662.

This volume which is the fifth of a series is up to the high standard which has been maintained through all the volumes of the series. It takes in subjects from M "Methyl Blue" to R "Rabies." The illustrations and plates are excellent and the typograph, presswork and binding are of the best. Diseases are treated separately under the proper heading, and are divided in sections such as "Etiology," "Bacteriology," "Morbid Anatomy," "Treatment," etc.

THE STUDY OF BREEDS IN AMERICAN CATTLE, SHEEP AND SWINE. By Thomas Shaw. New York and Chicago: Orange Judd Company, 1900. Pp. 371. Price $1.50.

The book has been written, so the author tells us in his preface, for the purpose of discussing all the pedigreed breeds of cattle, sheep and swine at present existing in America, as well as the more important sub-breeds. From its general style we should judge that Prof. Shaw's study will be of considerable service to students of agricultural colleges. Fairly good illustrations accompany the text.

HELIOCENTRIC ASTROLOGY AND SOLAR MENTALITY. By Yarmo Vedra. Philadelphia: David McKay. 1899. 8vo. Pp. 266. Price $1.50.

OUR NEW PROSPERITY. By Ray Stannard Baker. New York: Doubleday & McClure Company. 1900. Pp. 272. Price $1.25.

The profoundly important readjustments which have taken place in our relations to other countries and in the attitude of the various parts of our country to one another, have been indicated in this book by grouping the significant facts of the present era of prosperity in such a manner as to show the general tendency of American

financial, commercial, industrial, and, to some extent, political affairs. Although not a complete review of the conditions in every branch of industry the book contains all the important facts and statistics in most departments of activity.

TOTAL ECLIPSE OF THE SUN. By Mabel Loomis Todd. New and Revised Edition. With Introduction by David P. Todd. Illustrated. Boston: Little, Brown & Company. 1900. Pp. 273. 16mo. Price $1.

The recent eclipse has aroused popular interest in the sun. A new edition of Mabel Todd's work having become necessary, the opportunity has been seized of incorporating an account of the eclipses of 1896 and 1898, so successfully observed in Nova Zembla and India, and of that of May 28, 1900.

LESSONS IN ELEMENTARY PHYSIOLOGY. By Thomas Huxley. Edited by Frederic S. Lee, Ph.D. New York: Macmillan Company. 1900. Octavo. Pp. 577. 177 illustrations. Price $1.40.

Thomas Huxley's "Lessons" are too well known to require any extended notice here. The new edition which lies before us has been carefully revised and brought up to date by Prof. Lee, of Columbia University, so that it now forms a complete modern, elementary text book on physiology admirably adapted for school and college use.

FOGNATURA DOMESTICA. By Attilio Cerutti. Milan: U. Hoepli. 1900. 16mo. Pp. 421. 200 Illustrations. Price $1.

An excellent little book on plumbing in the "Manuali Hoepli," of which series 600 volumes have been issued. It is to be hoped that at some time we may have in English a technical series which will compare with this one. The Weale series was an excellent one, but the volumes became superseded.

LE CONSTRUZIONI IN CALCESTRUZZO ED IN CEMENTO ARMATO. By Giuseppi Vacchelli. Milan: U. Hoepli. 1900 16mo. Price $1.

The author has prepared a valuable technical book on concrete and cement construction. It is one of the best treatises we have ever seen in any language upon the subject. It is profusely illustrated by 210 engravings.

INTRODUCTION TO SCIENCE. By Alexander Hill, M.D. New York: Macmillan Co. 1900. 16mo. Pp. 140. Price 40 cents.

One of the admirable little volumes of "Temple Primers." This little book aims at giving an account in popular language of the scientific problems which are most prominent at the present time, and attempts to portray the attitude of the mind of those engaged in solving them.

L'INCANDESCENZA A GAS. By Dr. Luigi Castellani. Milan: U. Hoepli. 1900. 16mo. Pp. 144. Price 50 cents.

We have never before seen a work on the manufacture of mantles for incandescent burners. The little volume before us is a thoroughly practical treatise on the subject, and our only regret is that it is in the Italian language and, therefore, cannot be of much use to those who do not read Italian.

HEMP. A Practical Treatise on the Culture of Hemp for Seed and Fiber, with a Sketch of the History and Nature of the Hemp Plant. By S. S. Boyce. New York: The Orange Judd Co. 1900. 12mo. Pp. 122. Price 50 cents.

Few plants adapt themselves as readily to cultivation and in as varying climates as does hemp. It was one of the first plants introduced into America by the Colonists, and there seems to be no reason why it should not again take its proper place among our national industries. The author has given great attention to the study of the hemp and his book is a most excellent one.

KELLY'S DIRECTORY OF MERCHANTS, MANUFACTURERS AND SHIPPERS AND GUIDE TO THE EXPORT AND IMPORT SHIPPING AND MANUFACTURING INDUSTRIES OF THE WORLD. London: Kelly's Directories, Limited. 1900. 14th edition. 8vo. Pp. 3,488. Price $10.

The portly volume before us is about the most satisfactory work of this kind that we have ever seen. Its index of trades is most exhaustive, and the large list of cities and towns is most comprehensive. As an example of that way in which the work is compiled, take Holland: First comes general information relative that country, then follow particulars as to the extent of commerce and imports to Great Britain; a long list of the various cities, principal manufacturers and merchants in each city, custom tariffs of all nations, a section devoted to trade marks, a large business directory of London, and a business directory of England, Scotland, Wales and Ireland. We notice a most amusing letter in the preface relative to Her Majesty's Secretary of State for Foreign Affairs. This letter is on a par with many of the British consular reports, and affords a painful contrast to our remarkably efficient Consular Service of the United States, our consuls not being deterred from making searching inquiries in regard to trade in foreign countries.

SOME STRANGE CORNERS OF OUR COUNTRY—THE WONDERLAND OF THE SOUTHWEST. By Charles F. Lummis. New York: Century Company. 1898. 12mo. Pp. 207. Price $1.50.

The book is handsomely illustrated, many of the cuts being wood engravings. The author deals with such subjects as "Grandest Gorge in the World," "The Forest of Agate," "The American Sahara," "Montezuma's Well," "Montezuma's Castle," "The Greatest Natural Bridge on Earth," "Stone Autograph Album," "The Navajo Blanket," and others equally interesting. The author tells his stories in a most pleasing style.

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The best book for electricians and beginners in electricity is "Experimental Science," by Geo. M. Hopkins. By mail, $4. Munn & Co., publishers, 361 Broadway, N. Y.

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Notes & Queries

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.

Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(7909) F. L. asks: 1. What causes the humming in electric street railway motors? They are noiseless when new, but after about six months or a year, they begin to hum. A. If this statement is true, we are not able to give a reason for it. There is no electrical cause which after this or any other period will develop a humming noise, nor any mechanical cause for such a universal effect. We suggest a broader investigation to see if all motors hum at the end of six months. 2. In cast-welding rail joints do they allow for any expansion or contraction? If so, how? A. No. If the joint is made stronger than the force of contraction, the rail will not break. If the rail is held down more rigidly than the force of expansion, it cannot break away from its fastenings. Hence, it will stay in its place both in winter and in summer. This is the theory. 3. Is there any direct incorporation of the metal, in the rail and in the cast? I have heard some claim there is not, while others claim that the rail is fused at one or two points, generally about the size of a half dollar, where there is a direct union of the two metals. A. There is firm adhesion. We do not know whether there is incorporation or not of the two metals. 4. We have made a box-kite, with 2 cells, 16 inches long, and 15 inches square, with about 10 inches clear between them. When we try to set it up it will dive down, after going up about 25 or 30 feet, sometimes hitting the ground and breaking some of the sticks. A. We advise you to apply to the Weather Bureau at Washington, D. C., for the plans and construction of a box-kite.

(7910) J. B. P. asks: 1. Will you please advise me of some compound, or chemical, that will clean scales from a boiler, while boiler is in use, without any risk of burning the boiler, by water foaming? A. For keeping a boiler clear of incrustation there is nothing so easily managed as caustic soda or potash lye. Dissolve about a quarter pound of the soda or lye for each horse power of the boiler in a barrel or tub of water and connect it with the suction of the feed water pump. Use the boiler for a day with the soda in. Then blow out from the boiler after the fires are drawn or banked or when the engine stops, to the level of the lower gage cock or bottom of water gage and pump up with fresh water to high water mark. Use the boiler next day as usual and at night after fires are drawn and walls cooled below the temperature of injury to the boiler, blow out all the water and clean out the boiler. This may be repeated according to the condition of the boiler, once or twice a month. See Davis' book on "Boiler Incrustation," $1.50 by mail. 2. Can I charge a set of storage shells by connecting them in series, in main circuit, batteries having the same capacity in amperes and voltage, as the circuit, and will the batteries cause the lamps to burn dim? Would an ammeter connected in the circuit answer to tell when the batteries were fully charged? A. Connect the cells in series and to the line through the ammeter and a rheostat by which the amount of current can be adjusted. A good charging rate is 2½ amperes per square foot of positive plates, reckoning both surfaces. The final voltage should be 2½ volts per cell. This you must determine by a voltmeter in shunt with the cells. Stop the charging when this is reached. As you must put the cells in shunt with the lamps on the circuit, the charging of the cells cannot affect the light if the dynamo has capacity enough to charge the cells and light the lamps at the same time. A good book for one having charge of a storage battery is Treadwell's, price $1.75 by mail.

(7911) E. L. C. writes: Kindly inform me how to copper-plate—a good heavy plate. I wish to plate some steel and iron wire, 2 feet long and about 12 gage. I would also like to plate some wood a good heavy copper plate. I have tried a receipt from some book, but with little or no success, as the plate will not stay on the iron or steel when I rub or try to polish it, and some will not take at all. A. Your trouble probably is not due to the defects of the description in the book which you have followed, but to your own inexperience. The only way to become an electroplater is to learn the trade from some one who understands it practically. No description can prevent you from making mistakes, or tell you how to recognize the proper working of the process and the proper condition of the bath and the article to be plated. Had yours been all right, the coating would have formed properly and adhered. Such points must be learned by actual experience in actual work. We are not electroplaters and cannot teach electroplating. We recommend Watt's book, price $1.

(7912) G. A. H. asks: Can you give a description of a sketching camera that reflects direct from the photograph and not from a transparency or negative, and how to arrange the reflectors and lens in a lantern to do the same? A. We think you will find what you want in a "sketching camera" in Hopkins' "Experimental Science," price $4 by mail. He there describes a camera for projecting opaque objects, so as to project them upon a screen, as slides are projected by an ordinary lantern. If you place the screen where you wish the picture to fall as you sketch it, you will have a sketching camera for the direct use of a photograph, or any opaque object.

(7913) W. S. D. writes: I wish to make a storage battery large enough to light two 16-C. P. incandescent lights for a few months, several hours a day. I would kindly ask you to please give me your opinion as to which book to get for the construction of such a battery, and if you could give me some information, I would be very thankful to you? A. We can supply you with the following books on the storage battery, "Salomon's Accumulators," price $1.50; "Treadwell's Storage Battery," price $1.75. Prices are by mail. We do not, however, advise amateurs to attempt the construction of a storage battery for real work. It is well enough to make a few cells for experimental purposes. Amateurs cannot expect to make cells which will have much endurance or efficiency, as compared with the cells made in a properly equipped factory, and by experienced workmen. In your case you wish to light 16-candle power lamps. These are rarely made for less than 50 volts. You will then need twenty-five cells with five or seven plates each. The cost will be very much greater than for the same amount of light obtained in some other way. The labor of making so large a number of cells is a great deal. You need as many cells as if you had a greater number of lamps. If you really must have electric lights from a storage battery, we would say buy the battery.

(7914) P. G. writes: 1. My boy is desirous of constructing a telephone line between two country houses about five hundred feet apart. Will you kindly answer in the SCIENTIFIC AMERICAN whether there is any danger from lightning? A. If your house is so situated that the line can be run along the eaves of the houses, there is little danger from lightning on the telephone line your son wishes to run in the city. It were safer to use lightning arresters as is usually done. 2. Is the bright light in the western sky early in the evening during the last month a star or an electric light sent "up in a balloon" from Edison's workshops at Menlo Park? I maintain that it is a star, but my friends have scoffed at me so much that I do not know where "I am at." I have tried to demonstrate by crude trigonometry that it must be a star, but they refuse to be convinced. Therefore I seek an answer from one whose authority will be unquestioned. May I hope that you will help me out? A. The light is doubtless the planet Venus. It would be impossible to raise a balloon high enough to have the light so far above the horizon. This is a frequent question, but has little reason under it. Mr. Edison has done many wonders, but is hardly wizard enough to raise a light which could compete with a planet in brightness. Mr. Edison's laboratory was removed from Menlo Park years ago to Orange.

(7915) J. L. C. asks: 1. Can you give details of construction of an acetylene search light that will project a narrow beam of light? A. An acetylene search light presents no peculiar conditions. Place the light in the focus of the reflector. Have the reflector adjustable so that it can be brought nearer or slid farther from the burner. You can adjust for best projection of the beam as may be required. 2. How would be the best way to reinforce the above light, to increase the size of the burner, or to add individual burners? A. You cannot obtain all sizes of burner for acetylene. To increase the illumination you must add to the number of burners. They are usually placed tandem, and not abreast, when used for projection.

(7916) J. E. P. asks: 1. How to remove the elements from a Hercules battery cell after the salts have crystallized, forming a solid mass of zinc, carbon and jar. I have about a dozen cells in this condition, and it is impossible to get the elements out of the jars. A. We would suggest that you soak your cells in water, thus dissolving the crystals which have formed. This will be a slow operation. It will hasten matters to dig out all the crystals which can be got at with any sharp-pointed tool. Sulphuric acid will dissolve the substance more rapidly, but it will also consume the zinc, which you are probably desirous of saving. In this case prevention is better than cure. 2. Can satisfactory results be got from compressed air in an ordinary steam cylinder, and how high a pressure is necessary per rated horse power of engine to get best results? A. The best steam engine is also the best for compressed air. Only a very little higher pressure or longer cut off is needed to give the same results for air as with steam for power.

(7917) L. A. S. asks: 1. What per cent of electricity, going out through the trolley wire, gets back to the dynamo through the rails or ground? A. All the current returns to the dynamo in one way or another. 2. Would it be possible under existing conditions of insulation, to send the current out through the rails and back to the dynamo through the trolley wire, and if so, would the electrical efficiency be the same? A. The trolley wire is made plus, not as you seem to think, because the current might not go out properly if sent out by the rails, but to protect metals, water and gas pipes, etc., from corrosion at much as possible. It makes no difference to the electrical efficiency which wire is attached to the trolley, the plus or the minus. If, however, the current flows from the trolley wire to the ground on its way back to the station, it will not act by electrolysis so much upon the metal which it traverses, as if it flowed in the opposite direction. Iron and lead are positive, and tend to attach themselves to the negative pole of the circuit. If then the rails, and water and gas pipes are in the direction of the flow of the circuit, they are not reduced by electrolysis as they should be if the current were flowing the other way, from the rail to the trolley wire.

(7918) L. H. R. asks: 1. Does a static electric machine depend for its volume of electricity on the superficial size of plate or velocity, and will a sufficient series of plates at a greater speed give off very much electricity at a high speed on one large disk, at 200 or 300 revolutions? Please answer an old reader in query column next issue, to satisfy a difference of opinion. A. The discharge of a static machine depends upon several conditions, size of plates, swiftness of rotation, dryness of plates, absence of dust, etc. The spark cannot much exceed the radius of the plates in length, since it will find the distance less between the combs if the balls are separated more than half the diameter of the plates, and will pass between the combs taking the axle of the machine on its way across. This is the reason for using as large plates as convenient. Glass is the best substance for the plates. Since there is a limit to the safe speed for glass, hard rubber is now used a great deal. This can be run at any speed desired, and a very strong spark can be produced. It is better to use several smaller plates than one large one, because of compactness and neatness of appearance. A well-made machine with two 18-inch plates of hard rubber, driven by a quarter horse power motor, gives a steady stream of sparks at 1,800 revolutions per minute. It may also be driven by hand, though no one can maintain that speed very long. 2. Are mica plates superior to glass? A. Mica differs very little from glass in its inductive capacity, and would serve equally well for the plates of a static machine, if pieces of sufficient size could be had at a moderate cost.

TO INVENTORS.

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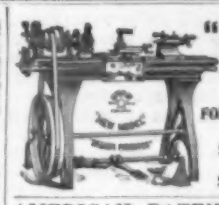
Telephone exchange system, W. Smith 652,928

(Continued on page 31)



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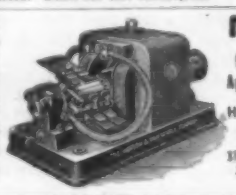

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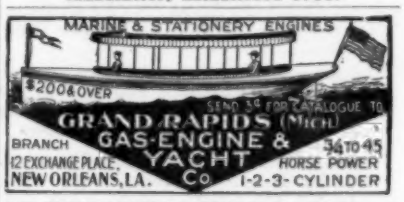
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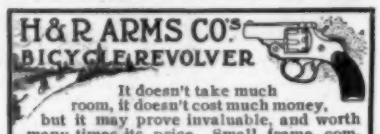

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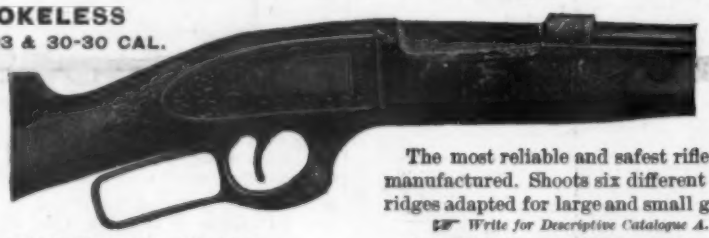

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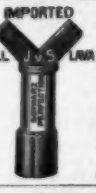

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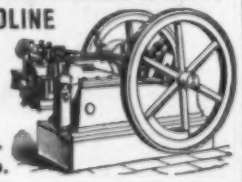

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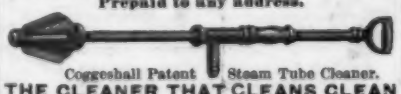

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